ANALYSIS OF DONOR SITE HEALING FOLLOWING HARVESTING OF SPLIT SKIN GRAFT

Dissertation

Submitted to

THE TAMILNADU Dr. MGR MEDICAL UNIVERSITY

In Partial fulfillment of the requirement for

the award of degree of

M.Ch. DEGREE EXMINATION

BRANCH - PLASTIC SURGERY (BRANCH – III)

THE TAMILNADU

DR. MGR. MEDICAL UNIVERSITY

CHENNAI

AUGUST 2012

CERTIFICATE

This is to certify that this dissertation in **"ANALYSIS OF DONORSITE HEALING FOLLOWING HARVESTING OF SPLIT SKIN GRAFT"**, is a genuine work done by **Dr.R. ARUN KUMAR** under my guidance during the period of 2009 – 2012. This has been submitted in partial fulfillment of the award of M.Ch Degree in Plastic Surgery (Branch – III) by The Tamil Nadu Dr.M.G.R. Medical University, Chennai.

Prof.V. JAYARAMAN
M.S., MCh., MNAMS., Dip. N.B., Ph.D., FICS.,
Prof. and Head of the Department,
Department of Burns, Plastic &
Reconstructive Surgery,
Kilpauk Medical College & Hospital,
Chennai – 600 010.

Dr.P.RAMAKRISHNAN.,
M.D., D.L.O.,
Dean,
Kilpauk, Medical College &
Hospital,
Chennai – 600 010.

ACKNOWLEDGEMENT

I express my sincere thanks and gratitude to **Dr.P.RAMAKRISHNAN, M.D., D.L.O.,** Dean, Kilpauk Medical College and Hospital for permitting me to utilize the clinical materials of this hospital.

I have great pleasure in thanking my teacher **Prof.V.JAYARAMAN, M.S., M.Ch., MNAMS., Dip. N.B., Ph.D., FICS.,** Professor and Head of the Department, Department of Burns, Plastic and Reconstructive Surgery, Kilpauk Medical College and Hospital, Chennai-10, for his valuable support in the conduct of the study and for his valuable guidance, suggestions and supervision throughout my career and my period of study. I thank my professor for being helpful in successfully completing this dissertation.

My sincere thanks to **Prof.S.R.VIJAYALAKSHMI, M.S., M.Ch.,** Former Head of the Department for her guidance and suggestions throughout my study period.

My sincere thanks to **Prof.N.RAMESHKUMAR, M.S.,M.Ch., Prof.K.GOPALAKRISHNAN, M.S., M.Ch, and Prof.J.JAGAN MOHAN, M.S.,M.Ch.,** for their continuous guidance and suggestions throughout my period of study.

My sincere thanks to all my Assistant Professors who have given full support by guiding me throughout the period of this study with their valuable advice.

Finally, I would like to place on record my sincere thanks to all my patients for their immense cooperation without which this study would not have been possible.

CONTENTS

PROFORMA

Name age/sex

I.p .no

Occupation

Address

Details

Donor site Size

Investigations

- Blood haemoglobin
- Blood sugar
- Blood urea
- Serum creatinine
- Serum protein
- Blood group
- Wound swab for culture and sensitivity

Closed dressing

Combination dressing

Date of application

Pain score(48 hrs)

- Numerical rating score
- Facies rating score

Ambulation- post operative day

Reepithelisation- day

Haaemocoagulase

Collagen sheet size used

Cost

Review of Wound

POST OPERATIVE DAY	DRESSING REMARKS
DAY 1	
DAY 2	
DAY 3	
DAY 4	
DAY 5	
DAY 6	
DAY 7	
DAY 8	
DAY 9	
DAY 10	
DAY 11	
DAY 12	
DAY 13	
DAY 14	
DAY 15	
DAY 16	
DAY 17	

DAY 18

DAY 19

DAY 20

DAY 21

DAY 22

DAY 23

DAY 24

DAY 25

DAY 26

DAY 27

DAY 28

DAY 29

DAY 30

DAY 31

Complications

Group-I

Dressing soakage

Overpadding

Infection

Framycetin application

Group -II

Displacement of collagen

Infection

Date of discharge

ANALYSIS OF DONOR SITE HEALING FOLLOWING HARVESTING OF SPLIT SKIN GRAFT

ABSTRACT

AIM :

To Study

1. The problems encountered during the process of donor site healing following harvesting of split skin grafts

   PAIN
   AMBULATION
   REEPITHELISATION
   DONOR SITE INFECTION

2. Comparative study between Closed and Open dressing (Haemocoagulase + Collagen) for the skin graft donor site and its influence on the above factors associated with donor site healing

MATERIALS AND METHODS:

Closed dressing with sterile Vaseline gauze and Open dressing using Botroclot with sieved moist collagen were applied to two different subsets of 50 donor sites following Split Skin Grafts in each group (TOTAL -100)

INCLUSION CRITERIA:

- All donor sites of the Split Skin Grafts
- All patients were treated with vitamin and protein supplements and appropriate antibiotics.
- Blood transfusion to keep Haemoglobin minimum at 10gm%

EXCLUSION CRITERIAS :

Patients with Diabetes mellitus, Hypoproteinemia, Anemia were excluded from study.

Large donor site raw areas were excluded from study in both groups.

FACTORS ANALYSED:

- Pain
- Early Ambulation
- Re epitheliation of the donor site wounds after 2 weeks
- Cost factor analysis
- Complications

PERIOD OF STUDY- NOVEMBER 2009 TO JANUARY 2012

OBSERVATION & RESULTS

PAIN

In our study, among the patients the who had the conventional donor site dressing with meshed Vaseline gauze had a median pain score of 5 observed in 23 patients. Minimum pain score in this group was 3 noted in 2 patients. Maximum pain score was 6 experienced in 4 patients. Pain score of 4 was noted in 21 patients.

In comparision the Combination Dressing group with Haemocoagulase and Collagen Dressing had different results. The median pain score was 2 experienced in 27 patients. Minimum pain score was 1 noted in 6 patients. Maximum pain score noted in the collagen dressing group was 4 observed in 4 patients. The remaining 13 patients experienced a pain score of 3. Pain was drastically reduced in the Collagen Dressing patients.

AMBULATION

Since the pain score was high in the closed dressing subset of patients, it limited their mobilization and 22 patients were ambulant only on postoperative day 3. Only 10 patients were ambulant on the 2nd post operative day. The remaining 18 patients ambulated well only on the 4th postoperative day.

Due to the decreased pain in the collagen dressing for the donor site patients ambulated early and 27 patients were ambulant from 1 st postoperative day.

Subsequently 21 patients were ambulant on 2nd post operative day. The remaining 2 patients ambulated on the 3rd postoperative day. Early ambulation was noted in the in patients with the collagen dressing

RE EPITHELISATION

Donor site reepithelisation was assessed in the closed dressing by the loosening of the dressings average time taken for the donorsites to reepitheliase was 20 -23 days. Due to complications of donor site infection the donor site healing extended to 29 -31 days in about 6 patients.

Donor site reepithelisation was noted between 15-17 days in the collagen dressing group. In 2 patients donor site healing was delayed to 21-23 days due to donor site infection which was treated by conservative methods due to the ease of inspection of donor site and had the advantage of early identification of donor site complications. In 1 patient there was displacement of collagen sheet from the donorsite and it was converted to closed dressing and excluded from study. The healing time noted in that patient was 23 days.

COST FACTOR ANALYSIS

The cost for the conventional Closed Dressings was Rs .150 inclusive of the over padding needed in review period. The cost factor for application 25x40 cm Collagen Sheet to the donor site was Rs.450.

DONOR SITE COMPLICATIONS

Infection

Donor site infection was noted in 6 patients of the Closed Dressing group. It was managed with conservative dressings with Framycetin.

Donor site dressings on periodic review showing excessive soakage with foul smell were opened end wound swabs taken

Donor site infection noted in 2 patients in the Collagen Dressing group, conservative dressings done to treat with the infection in these patients.

Collagen Displacement-

1 patient in the study group had shearing of collagen sheet when applied to donor site in the postoperative period. Wound was cleaned and Closed Dressing applied and patient was excluded from the study.

CONCLUSION

Haemocoagulase with Collagen sheet application for donor site have the following advantages.

- Less pain over the donor site compared to the conventional Closed Dressing with Vaseline gauze.
- Early ambulation due to reduced pain after the application of Collagen Sheet to the donor site.
- Reepithelisation complete for most patients and time of reepithelisation is similar to the standard expensive dressings for the donor site.
- Inspection of the donor site wound can be done easily and complications can be recognized early.
- A Comfortable Dressing due to the decreased bulk of dressing and ease to wear the garments over the dressing.
- Less complications and better outcome compared to the conventional closed dressing.

INTRODUCTION

Skin is the largest organ of the human body, representing approximately 16% of the total body weight. While the functions of protection and thermoregulation are well recognized, skin also has important metabolic functions in protein and vitamin D metabolism. The human body produces the greatest amount of vitamin D in the epidermal layer of the skin[17]. In addition to providing a physical barrier to pathogenic organisms, skin functions as an active immune organ with distinctive antigenic properties that play a significant role with particular regard to composite tissue allo trans plantation.[30]

Restoration of an intact barrier is of critical importance and may be achieved in numerous ways, including grafting. Among the indications for skin grafting are promotion of accelerated healing of burns and other wounds, reduction of insensible fluid loss, and protection from bacterial invasion, reduction of scar contracture, enhancement of cosmesis,

Skin grafts are used to cover extensive wound areas or wounds which may result in scarring. Donor site wounds are often more painful than the skin graft wound. Skin graft and donor site wounds should be cared for by a knowledgeable practitioner trained in the care and management of skin graft and donor site wounds. It is of vital importance that the patient is aware that in order to heal the original wound a second wound must be created, which will also produce a scar. The patient

should also be warned that the donor site wound may be more uncomfortable than the graft site wound due to the exposure of sensory nerve endings (Weber et al, 1995).

Inspite of newer advances split thickness skin grafts(STSG) still have an important place in many areas of plastic surgery. Though the technique of skin grafting is more or less standardized the treatment of the donor site differs greatly and has been a topic of debate. The STSG donor site usually receives little attention and is often a source of delayed healing with considerable pain and discomfort to the patient. Thus it is not uncommon for patients to complain more about the pain at the donor site than at the site of surgery.

Skin is natural barrier that prevents penetration of pathogens and escape of interstitial fluid. The harvest of a split thickness skin graft causes a partial thickness injury and an outflow of blood and protein rich exudate from the wound. This exudate and coagulated blood combine to form an eschar which provides a temporary cover to the wound and underlying regenerating epithelium. However the eschar does not prevent tissue desiccation and infection at the donor site which can thus convert a partial thickness injury to a full thickness loss. After the harvest of STSG, the new epidermis arises from proliferation of the remaining epithelial cell layer at the donor site periphery and reserve cells in the remaining hair follicles, sebaceous glands and sweat glands. This is the first phase in

the healing of a donor site. The process of cell proliferation is followed by migration of the cells outward until the wound is reepithelialised.2 Complete re-epithelialisation occurs in 10-14 days, although the rate may be affected by the thickness of graft taken. (23)

Healing of donor site wounds occurs through reepithelialisation. Epithelial cells migrate from the remnants of hair follicles, sebaceous and sweat glands remaining in the reticular dermis of the skin and spread across the wound bed until full skin integrity is restored. This usually occurs within 7–10 days, but may take as long as 21 days, depending on the age and nutritional status of the patient. Wound healing in the elderly may be speedier if the surgeon uses a small amount of the skin graft and widely fenestrates it to apply as a dressing to the donor site (Fatah and Ward,1984). The dual action of the skin graft spreading across the wound, together with re-epithelialisation from the remains of hair follicles, sweat and sebaceous glands would speed healing. In the first 3–4 days post surgery, the donor site wound produces moderate to heavy amounts of exudate, depending on the size of the wound area. After this, exudate levels diminish as re-epithelialisation progresses.

To minimise discomfort for the patient it is vital to use an appropriate dressing. Removal of an inappropriate dressing can cause a great deal of pain and may even delay wound healing (European Wound Management Association[EWMA], 2002). One dressing which could be

applied to the donor site and left in situ until the wound is healed would be ideal. However, this is unlikely due to the variability of patient, skin texture, wound site, etc. The goal of treating skin graft donor sites is to promote healing while minimizing the risk of introducing new complications and pain to an already traumatized patient. Moist wound healing is not a new idea and providers continue to strive to find the optimal treatment that provides this ideal, moist environment.

Collagen dressings used are composed of type 1 and type 3 bovine collagen which is similar to human collagen and thus prevents rejection. It is commercially available in a sterile pack and is thus easy to use.

Collagen as a donor site dressing has shown that the time to complete reepithelialisation is comparable with other dressing materials (28). However it is not possible to assess the true wound healing as the wound cannot be kept under continuous observation and the mean time to the first dressing may be longer. Thus many of the donor sites may have healed long before they are first inspected.

Patients with collagen dressings are found to have only minimal to moderate pain in the entire post operative period and during the first dressing. In these patients analgesic requirement is reduced and early mobilisation can be done. Thus the major advantage of using collagen as a donor site dressing is decreased pain. The collagen sheet once adherent

to the wound has low friction between the wound surface and dressing and this has made it suitable for awkwardly sited donor sites. Also once applied it does not require a bulky dressing which would hamper mobilisation, or require a change of dressing as there is no soakage of the dressing due to wound exudate.

The collagen provides a scaffolding for epithelial regrowth and prevents exudation from the raw area. (14,72) After 48 hours the film is transformed into a stiff sheet which is stable enough to withstand pressure and shearing of clothes. Thus it protects the donor site from mechanical trauma and infection and decreased loss of protein in exudate. When reepithelialisation is completed the overlying film and coagulated blood separates spontaneously. Thus removal of the dressing is easy and pain free.

Disadvantages seen with the use of a collagen dressing is the formation of an haematoma in cases where meticulous haemostasis has not been achieved. Also infection at the donor site causes a complete degradation of the film and is associated with significant donor site pain. Thus donor site pain in patients where collagen dressing is used is highly suggestive of wound infection. (26,27) The wound infection is usually limited to the donor area with no associated systemic infection, and it

does not convert the donor site to a full thickness loss and once the wound is redressed it does not affect the time of reepithelialisation.

Thus collagen dressings appear to have a great advantage over other dressing materials for donor sites especially in terms of a pain free donor site and thus early mobilisation of the patient and a decreased morbidity. With its ease of application, with no need for redressing, a pain free donor site reepithelialisation in the accepted time it attempts to fulfil the criteria of an ideal donor site dressing.

AIM OF THE STUDY

AIM

To Study

1. The problems encountered during the process of donor site healing following harvesting of split skin grafts

   PAIN

   AMBULATION

   REEPITHELISATION

   DONOR SITE INFECTION

2. Comparative study between Closed and Open dressing (Haemocoagulase + collagen) for the skin graft donor site and its influence on the above factors associated with donor site healing.

REVIEW OF LITERATURE

HISTORY

The history of skin grafts has its beginnings in ancient India, where Sanskrit texts document skin transplants performed by Hindus in 3000-2500 BC. Potters and tilemakers of the Koomas caste were reconstructing noses which had been mutilated as punishment for crimes such as theft and adultery. Grafts were obtained from buttock skin, which was reportedly slapped with a wooden paddle until red and congested, and then cut with a leaf to the appropriate size .

Despite early attempts at plastic and reconstructive surgery, hundreds of years passed until further work advanced the practice of skin transplantation. In Italy in1442 AD, Brancas developed a novel technique of binding the patient's arm to the site of the skin graft . Brancas used skin from the arm to transplant a slave's nose to his master's nose. He unfortunately did not receive recognition for his technique of nasal reconstruction, which was instead credited to his fellow countryman, Tagliacozzi, over a hundred years later. Tagliacozzi, who is considered to be the pioneer of modern plastic surgery, publicized Brancas' method of skin grafting. Although he repaired soldiers' facial battle wounds, the most common reason for nose deformities at that time was tissue infection due to syphilis. In 1597, Tagliacozzi published his work in "De

curtorum chirurgia per insitionem," and in so doing, transformed plastic surgery from a trade service to a scientific procedure .

Prior to the 1800's, reports (if skin grafting were mostly anecdotal. In 1663, the Royal Society of London attempted experimental skin grafts using a dog . After a few failed attempts at securing the graft, followed by the escape of their canine subject, research in that area was temporarily abandoned. In 1731, Garengeot was ridiculed when he reported his experience of warming in wine and then reattaching a soldier's partially amputated nose . Although the Italians had been performing skin transplantation for quite some time, news of India's longstanding method of skin grafting was only first reported in Europe in 1794 .

The nineteenth century would prove to be the most influential period with regard to the advancement and acceptance of skin grafting.In 1804 Baronio demonstrated the first successful autograft using the backs of sheep . By 1823, Bunger achieved the same success with autografts in human subjects. Attempting to revive the ancient Indian method of rhinoplasty, Bunger repaired nasal defects using full-thickness skin grafts from the patient's thigh .

In 1869, the Swiss surgeon Reverdin performed the first allograft by pinch grafting very thin pieces of epidermis ('epidermic grafts') . Using this firstsplit-thickness skin graft, Reverdin demonstrated a more rapid healing of granulating wounds. Two years later, Oilier furthered

Reverdin's work and demonstrated a better outcome by using skin grafts that were not only composed of epidermis, but also contained a portion of the dermis . These dermoepidermic' grafts effected faster wound healing with less scarring. In 1871 Pollock introduced the idea of using skin grafts to treat burn wounds . He donated small pieces of his own skin which he used in conjunction with a burn victim's skin to cover a large denuded area. The idea was brilliant and paved the way for one of the most important modern functions of skin grafts, the treatment of burn victims. By the end of the century, Wolfe had introduced full- thickness skin grafts into clinical practice to treat ectropion, and Girdner (14) had published the first report of skin grafting with human cadaveric skin.

The use of skin grafts revolutionized the care and ultimately the mortality of burn patients. The evolution of the practice of skin grafting in the twentieth century has concurrently advanced our understanding of the biology of wound healing and the immunology of transplant rejection. Skin grafting continues to be a science in progress.

George Winter is often referenced as a pioneer among wound-care practitioners because of his work in the early 1960s that proved wounds re-epithelialize quicker in a moist environment (Winter, 1963). It is indeed the epithelialization process on which we focus when treating the skin graft donor site.An old and still practiced strategy is to cover the wound with petrolatum (paraffin) gauze and allow it to dryout. Drying

was often accomplished with the use of hair dryers, heating blankets (bear huggers), or air drying. The procedure often resulted in pain and discomfort for the patient, and vigilance was needed to regularly trim the edges of the dressing as it peeled away from the healing wound. If not done, the dressing could catch on clothing or linen, causing pain to the patient, trauma to thewound, and necessitating a repeat of the drying process. Essentially, the wound was left open to scab, which is contradictory to the best evidence-based practice of today, that of moist wound healing.

In recent years, much has been published highlighting the benefits of moisture-retentive dressings in treating donor sites. Moisture-retentive dressings that have been used include hydrocolloids, foams, and transparent thin film dressings, alone or in combination with absorbent materials such as alginates, hydrofibers or gauze. While hydrocolloids and foams provide the needed absorbency, they must be removed whenever wound inspection is required, increasing treatment cost and the risk of traumatizing the wound. Thin film dressings allow for wound visualization, but usually fail to contain the drainage for more than 24 hours, even when used secondary to other absorbent dressings(which also negates the benefit of transparency). The importance of rapid healing in skin graft donor sites is emphasized by the increasing number of methods designed to achieve earlierreepithelialization [17]; however, other unique concerns are associated with the skin

graft donor site. In large burns, improved healing may allow for faster reharvesting, whereas in smaller injuries, hastened epithelialization may result in less scarring.

Conversely, a secondary infection may either slow the healing process or ultiimately convert a partial skin-thickness donor site to a full skin-thickness loss . [70,30]. Thus, size of the donor site, site selection, skin preparation, graft depth, hemostasis (23), [57], and choice of dressing become important considerations. All of these issues have a role in the ultimate healing of a skin graft donor site and in the incidence of infection.

Accelerated healing at skin graft donor sites has enormous advantages to patient health. When large burn injuries decrease the availability of viable donor sites, one option available to surgeons is subsequent reuse of a donor site after it has completely re-epithelialized. However, producing a viable split thickness skin graft from a previously harvested donor site can take as long as 3 weeks.[70].

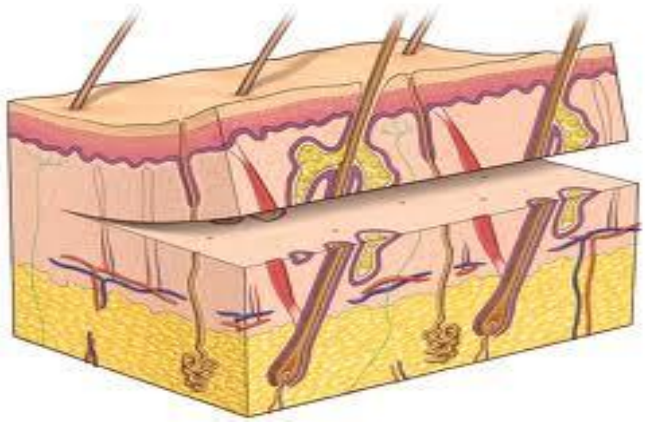
Once a graft is harvested the dermis lost at donor site is not replaced. Only reepithelisation occurs and epidermis is formed. The dermis harvested is a net loss at the donor site. Repeated harvesting at same donor site cause progressive thinning of dermis at donor site.Subsequent layers of graft are less elastic. An ideal dressing method prevents dehydration and infection while facilitating wound healing.

Conventional donor-site dressings consist of vaseline gauze and gauze dressings. While many plastic-surgery units have moved away from these, other disciplines use skin grafts and still use this type of dressing. Vaseline gauze dressings have many disadvantages as they are permeable to bacteria when wet.

They also allow the donor site to dry out and – as well as being prone to slipping, exposing nerve endings – they adhere to those nerve endings. Other disadvantages include their bulk and the fact that the patient cannot bathe.

Biological dressings like collagen are impermeable to bacteria, and create the most physiological interface between the wound surface and the environment. Collagen dressings have other advantages over conventional dressings in terms of ease of application and being natural, non-immunogenic, non-pyrogenic, hypo-allergenic, and pain-free.

ANATOMY



The skin consists of 2 layers . The outer layer, or epidermis, is derived from ectoderm, and the thicker inner layer, or dermis, is derived from mesoderm. The epidermis constitutes about 5% of the skin, and the remaining 95% is dermis.

The skin varies in thickness depending on anatomic location, gender, and age of the individual. Skin is thickest on the palms and soles of the feet, while the thinnest skin is found on the eyelids and in the postauricular region. Male skin is characteristically thicker than female skin in all anatomic locations. Children have relatively thin skin, but around age 11 years, the skin progressively thickens. This thickening continues until the fourth or fifth decade of life, when the skin begins to thin, primarily due to loss of dermal elastic fibers, epithelial appendages, and ground substance.

EPIDERMIS

The epidermis, the more external of the two layers, is a stratified squamous epithelium consisting primarily of keratinocytes in progressive stages of differentiation from deeper to more superficial layers. The epidermis has no blood vessels; thus, it must receive nutrients by diffusion from the underlying dermis through the basement membrane, which separates the 2 layers.

DERMIS

The dermis is a more complex structure. It is composed of 2 layers, the more superficial papillary dermis and the deeper reticular dermis. The papillary dermis is thinner, consisting of loose connective tissue that contains capillaries, elastic fibers, reticular fibers, and some collagen. The reticular dermis consists of a thicker layer of dense connective tissue containing larger blood vessels, closely interlaced elastic fibers, and coarse, branching collagen fibers arranged in layers parallel to the surface. The reticular layer also contains fibroblasts, mast cells, nerve endings, lymphatics, and some epidermal appendages. Surrounding the components of the dermis is the gel-like ground substance composed of mucopolysaccharides (primarily hyaluronic acid), chondroitin sulfates, and glycoproteins.

EPITHELIAL CELL SOURCES

Epidermal appendages are important sources of epithelial cells that re-epithelialize when the overlying epithelium is removed or destroyed in patients with partial thickness burns, abrasions, or split-thickness skin graft harvesting. These intradermal epithelial structures, such as sebaceous glands, sweat glands, and hair follicles, are lined with epithelial cells with the potential for division and differentiation. They are found deep within the dermis and in the subcutaneous fat deep to the dermis.

SEBACEOUS GLANDS

Sebaceous glands, or holocrine glands, secrete sebum, which serves to lubricate the skin and make it more impervious to moisture. They are found over the entire surface of the body except the palms, soles, and dorsum of the feet. They are largest and most concentrated in the face and scalp where they are the site of origin of acne.

SWEAT GLANDS

Sweat glands, or eccrine glands, are found over the entire surface of the body except the lips, external ear canal, and labia minora. They are most concentrated in the palms and soles of the feet. The normal function of the glands is to produce sweat, which cools the body by evaporation.

APOCRINE GLANDS

Apocrine glands are similar in structure but not identical to the eccrine sweat glands. They are concentrated in the axillae and anogenital regions. They probably serve a vestigial sexual function because they produce odor and do not function prior to puberty.

HAIR FOLLICLES

The hair follicle is another important source of epithelial cells, and many of the other epidermal appendages actually open into the hair follicle rather than directly onto the skin surface

PHYSIOLOGY OF SKIN

Functions of the skin include.

1. Protection
2. Homeostasis
3. Excretion
4. Temperature regulation
5. Vitamin D production
6. Sensory perception
7. Psychosocial function, and
8. Wound healing.

SKIN GRAFTS

Thought to have originated in India more than 2,500 years ago, skin grafting is the next step on the reconstructive ladder for the closure of a wound that cannot be closed primarily.

Skin transplanted from one location to another on the same individual is termed an autogenous graft or autograft. Skin grafts are classified as either split-thickness or full-thickness, depending on the

amount of dermis included in the graft. A partial or split-thickness skin graft (STSG) contains a variable thickness of dermis, while a full-thickness skin graft (FTSG) contains the entire dermis. Split-thickness skin grafts are further categorized as thin (0.005-0.012 in), intermediate (0.012-0.018 in), or thick (0.018-0.030 in) based on the thickness of graft harvested.

The thicker the dermal component, the more the characteristics of normal skin are maintained following grafting. This is because of the greater collagen content and the larger number of dermal vascular plexuses and epithelial appendages contained within thicker grafts. However, thicker grafts require more favorable conditions for survival because of the greater amount of tissue requiring revascularization. The choice between full- and split-thickness skin grafting depends on wound condition, location, and size, as well as aesthetic considerations.

FULL-THICKNESS SKIN GRAFTS

Full-thickness skin grafts are ideal for visible areas of the face that are inaccessible to local flaps or when local flaps are not indicated. Full-thickness grafts retain more of the characteristics of normal skin, including color, texture, and thickness, when compared with split-thickness grafts. Full-thickness grafts also undergo less contraction while healing. This is important on the face as well as on the hands and over mobile joint surfaces. Full-thickness grafts in children are more likely to

grow with the individual. However, full-thickness skin grafts are limited to relatively small, uncontaminated, well-vascularized wounds and thus do not have as wide a range of application as split-thickness grafts. Donor sites must be closed primarily or, more rarely, resurfaced with a split-thickness graft from another site.

SPLIT-THICKNESS SKIN GRAFTS

Split-thickness skin grafts can tolerate less ideal conditions for survival and have a much broader range of application. They are used to resurface large wounds, line cavities, resurface mucosal deficits, close donor sites of flaps, and resurface muscle flaps. They also are used to achieve temporary closure of wounds created by the removal of lesions that require pathologic examination prior to definitive reconstruction. Split-thickness skin graft donor sites heal spontaneously with cells supplied by the remaining epidermal appendages, and these donor sites may be reharvested once healing is complete.

Split-thickness grafts also have significant disadvantages that must be considered.

Split-thickness grafts are more fragile, especially when placed over areas with little underlying soft tissue bulk for support, and usually cannot withstand subsequent radiation therapy. They contract more during healing, do not grow with the individual, and tend to be smoother and shinier than normal skin because of the absence of skin appendages

in the graft. They tend to be abnormally pigmented, either pale or white, or alternatively, hyperpigmented, particularly in darker-skinned individuals. Their lack of thickness, abnormally smooth texture, lack of hair growth, and abnormal pigmentation make these grafts more functional than cosmetic. When used to resurface large burns of the face, split-thickness grafts may produce an undesirable masklike appearance. Finally, the wound created at the donor site from which the graft is harvested is often more painful than the recipient site to which the graft is applied.

GRAFT SURVIVAL AND HEALING

The ultimate success of a skin graft, or its "take," depends on nutrient uptake and vascular ingrowth from the recipient bed, which occurs in 3 phases. The first phase takes place during the first 24-48 hours. The graft is initially bound to the recipient site through formation of a fibrin layer and undergoes diffusion of nutrients by capillary action from the recipient bed by process called **PLASMATIC IMBIBITION.**

The second phase involves the process of **INOSCULATION**, in which the donor and recipient end capillaries are aligned and establish a vascular network.

REVASCULARIZATION of the graft is accomplished through those capillaries as well as by in growth of new vessels through neovascularization in the third and final phase, which is generally

complete within 4-7 days. Reinnervation of skin grafts begins approximately 2-4 weeks after grafting and occurs by ingrowth of nerve fibers from the recipient bed and surrounding tissue. Sensory return is greater in full-thickness grafts because they contain a higher content of neurilemmal sheaths.

Similarly, hair follicles may be transferred with a full-thickness graft, which allows the graft to demonstrate the hair growth of the donor site. Split-thickness grafts are usually hairless.

The amount of dermis present in the graft determines the degree of contraction immediately after harvest from the donor site and following placement and revascularization in the recipient bed. Freshly harvested grafts undergo immediate recoil as a result of elastin in the dermis in a phenomenon termed primary contraction. Therefore, a full-thickness skin graft contracts more initially following harvest as it contains the dermis in its entirety. Secondary contraction is likely due to myofibroblast activity in the wound bed and is defined as the contraction of a healed graft. The degree of secondary contraction is inversely related to the thickness of the skin graft.

Accordingly, split-thickness skin grafts contract more than full-thickness grafts following placement in the recipient bed. For that reason, full-thickness grafts are preferably used in areas that would be significantly impacted functionally or aesthetically by scarring or scar

contracture, such as the head and neck, hands, genitals, or breast. Current investigations into methods to reduce initial contraction and subsequent need for contracture release include early mechanical restraint immediately following grafting as well as application of topical agents to delay keratinocyte differentiation or prevent crosslink formation. [57]

DONOR SITE SELECTION

Donor site selection is based on multiple factors, including skin color, texture, dermal thickness, vascularity, and anticipated donor site .Split-thickness skin grafts are commonly harvested from the thigh, buttocks, abdominal wall, or scalp.

The method of harvesting the split-thickness skin graft depends primarily on the size and thickness needed for coverage of the defect. Smaller grafts can be taken using a "pinch graft" technique using a scalpel blade; slightly larger freehand grafts can be obtained with a Weck blade. Powered dermatomes such as the Zimmer (Zimmer, Inc.,) are most commonly used to harvest split-thickness skin grafts, as they have a rapidly oscillating blade that can be set at an adjustable depth and width for appropriate coverage of the defect.

Lidocaine with epinephrine may be injected subcutaneously at the donor site prior to harvesting, which aids in reducing blood loss and providing greater tissue turgor to facilitate graft harvest. The planned

harvest site and dermatome can be lubricated with mineral oil, sterile saline, or Shur-Clens (ConvaTec, Princeton, NJ) to enable easy gliding of the dermatome over the skin. Epinephrine-soaked gauze may be applied to the donor site immediately following harvest to achieve hemostasis.

Hemostasis:

Bleeding from a donor site is similar in amount to that of tangential excision of a fresh, deep dermal burn, i.e., diffuse, puncture, and profuse. Bleeding from a reused donor is even more profuse and again an analogy can be made with a tangential excision of a hyperemic wound. Because blood loss will be substantial, hemostasis at the donor site should be controlled before pursuing wound excision.

The ideal situation is the use of two teams, one whose role is to obtain skin grafts and maintain hemostasis. Pressure followed by application of fine mesh gauze or xeroform gauze, again followed by pressure (1 to 2 minutes) is usually adequate to control bleeding. As with the excised wound, topical thrombin or a diluted epinephrine solution can also be used.

DONOR SITE HEALING:

The split-thickness skin graft donor site epidermis regenerates by secondary epithelialization from the wound edges and from immigration of dermal cells originating in the shafts of hair follicles as well as adnexal

structures remaining in the dermis. Although the dermis never regenerates, the same site may be harvested again for subsequent grafts because only a portion is removed in a split-thickness graft. A skin graft is typically a thickness of skin comparable in depth to a partial thickness skin loss, i.e., epidermis and the upper third of the dermis. Typically, the slice of skin is 0.001 to 0.014 inches thick. A split thickness skin graft (STSG) of 0.001 inches typically contains the epidermis and upper third of the dermis, i.e., the papillary dermis. Appendages in the dermis to allow re- epithelialization in about 14 days. A 0.15 inch thickness graft usually contains about half of the dermal layer (or more) which includes a portion of the papillary dermis. Fewer epidermal cells remain and the site heals much slower, similar to a mid to deep dermal burn.

Protection of remaining epidermal and dermal elements is essential to allow for proper healing. The most bioactive portion of the dermis is removed with a STSG, i.e., the papillary dermis. The donor site healing will depend on when bioactive dermalgrowth enhancing factors are produced on the surface which can then stimulate re-epithelialization. Placement of a tissue engineered wound matrix on the donor site will provide active extracellular matrix components to stimulate healing.

The usual time for re-epithelialization of a donor site of 0.010 inch, in depth, is about 14 days in a patient 10 - 50 years old and about 21 days in a toddler or geriatric patient using a typical grease gauze dressing .The

donor site is not without impaired cosmesis, however, as(1) hypertrophic scar formation,(2) Thin Unstable scar or(3) changes in skin pigmentation can occur upon healing.

In the first 3–4 days postsurgery, the donor site wound produces moderate to heavyamounts of exudate, depending on the size of the wound area. After this, exudate levels diminish as re-epithelialisation progresses.

The healing of donor site wounds can be divided into two phases. The **WET** phase is when copious amounts of exudate is produced. An absorbent dressing such as a foam, alginate or hydrofibre dressing can be used to absorb the excess.

The **DRY** phase is when the exudate levels fall dramatically and the wound bed becomes dry. It can be treated with a simple non-adherent silicone dressing, which can remain undisturbed without adhering to the wound bed for several days or until the wound has healed. It is in the patient's best interests that one dressing is applied and remains in situ until healing is achieved. Unfortunately if an alginate or hydrofibre dressing is left in situ throughout healing, the dressing is likely to dry out and possibly adhere to the wound bed (6). Foam dressings draw excess moisture away and have low adherence to the wound bed so may be appropriate (Wilkinson,1997). Perhaps the most appropriate dressing is a simple nonadherent silicone dressing (Platt et al, 1996). During the initial

‘wet phase’ this would need padding and the outer dressing renewed regularly, otherwise the weight of the dressing could cause slippage, resulting in exposure of the wound and distress to the patient.

COMPLICATIONS:

A number of complications can occur in the donor site. Infection can occur which can result in deepening and possibly conversion of the wound to full thickness loss and ulceration.

Infection is usually evident from surrounding cellulitis. Systematic antibiotics as well as topical antibiotics are required for treatment. Blistering and continued breakdown are also seen, especially with deep donors or donors in small children or the elderly. Healing usually occurs in time. Hyper or hypo-pigmentation may persist for long periods of time and may be permanent. Hypertrophic scarring is seen especially in dark-skinned persons and with deep donor sites.

Delayed healing of skin donor sites may be costly and life threatening, especially in patients with large body-surface area burns. A donor site dressing should maximize the ability of the wound to heal without increasing the risk of local infection, systemic infection, or both. Specifically, the possibility of a secondary infection may either slow the healing process or ultimately convert the donor site to a full-thickness wound. A number of materials, ranging from gauze to

biological agents, have been investigated for use as donor sitedressings.

DONOR SITE HEALING AND THE WOUND ENVIRONMENT

Normal wound healing is a series of orchestrated events with an initiation phase, collagen deposition phase, keratinocyte ingrowth phase, and maturation phase. The process is dependent on oxygen delivery to tissue, pH of tissue, and development of a local wound environment conducive to the cells involved in repair. Growth factors provided exogenously or by repairing cells have been the focal point of numerous wound healing investigations,(4,49)1. Brown and associates [4] investigated epiderma1 growth factor (EGF) in association with skin graft donor site healing. This work showed that EGF decreased the time to healing to 7-17 days (mean: 10.9 days) compared with 9-21 days (mean: 12.3 days) for control donor sites.

Madden et al [42] showed that exudates from wounds occluded with a hydrocolloid dressing promoted keratinocyte proliferation.

DONOR SITE HEALING AND BACTERIA

Where healthy tissue exists and bacterial populations are noninvasive, wound healing proceeds in a normal fashion . In these cases, bacterial populations may stimulate the inflammatory response that initiates wound healing. Histologically observed invasion of

viable tissue by pathogenic organisms distinguishes invasive wound sepsis from colonization [71].

Noninvasive bacterial populations may remain over the surface of the wound without impairing healing below . [59]. The critical factor in wound healing appears to be the bacterial population in the wound, as opposed to the population over the surface of the wound. Bacterial populations vary over different parts of the body. This fact, plus concern for final cosmetic result, may influence donor site selection [23]. Preparation of the donor site area before harvest, as well as careful attention to hemostasis and clot removal from the bed after harvest, may be important for the control of microbial populations [57]. Depth of the donor area not only affects scar formation, but may also have a role in the incidence of infection [23]. As the depth of the wound increases, healing is slowed, and the wound becomes more susceptible to bacterial contamination as the time to healing is prolonged. When colonization of the wound occurs, there may be enhancement of the initial inflammatory response caused by skin harvest. If this inflammatory response persists, the ensuing pathologic finding of edema and mediator-induced necrosis may predispose the underlying tissue to invasion.

Early after harvest, the inflammatory response in the surrounding tissue may mask the inflammatory response associated with bacterial colonization. Hunt [31] showed the cascade of inflammatory events associated with normal wound healing; however, the inflammatory response compounded by microorganisms may be severe and lead to destruction of adjacent tissue [20]. Necrosis of tissue assists microbial invasion and conversion of the skin graft donor site to a full skin-thickness injury with a reported incidence of infection as high as 25%[21,30,42,70].

DONOR SITE DRESSINGS AND INFECTION

A donor site dressing should maximize the ability of the wound to heal without increasing the risk of local or systemic infection.

Donor site dressings are divided into several categories: **OPEN, SEMI-OPEN, SEMI-OCCLUSIVE, AND OCCLUSIVE.**

As early as 1962, Winter . (Winter CD)[76] showed that moist wounds healed faster than wounds left to dry out. This observation has led the care of skin graft donor sites away from the conventional dry gauze dressings toward the semi-occlusive or occlusive dressings. Although these occlusive dressings provide moist environments for wound healing, there has been concern that

occlusion of wounds would lead to increased infection.(40)1. However, Hutchinson and McGuckin. (30) , in a review of 29 donor site studies, showed an infection rate of only 2.7% in 594 occluded wounds versus an infection rate of 6.4% in 360 conventionally dressed wounds.

OCCLUSIVE TECHNIQUE

The early occlusive dressings consisted of a fine mesh gauze covered with an impermeable dressing; these were abandoned in favor of fine mesh gauze alone because of the potencial for bacterial proliferation and difficulty in application to many areas, especially those other than extremities (42).

SEMI-OCCLUSIVE TECHNIQUE.

The group of clear films often referred to as SAM dressings (synthetic adhesive moisture-vapor-permeable) was introduced for use on skin graft donor sites . They are also bacteria and liquid impermeable and so are considered semi-occlusive (23).

While the results of numerous studies have shown these dressings to promote more rapid and less painful healing, they tend to be labor-intensive, especially in large donor sites, because of the potential for large fluid collections. This problem often requires placement of a drain

beneath the dressing at the time of initial application or, altematively, frequent aspiration or changing of the dressing (76,40).

OPEN TECHNIQUE

The open technique of leaving the wound uncovered is the least expensive of any dressing, but is quite painful and is associated with prolonged healing times (72).

SEMI-OPEN TECHNIQUE.

Prior studies of fine mesh gauzes impregnated with various substances have described their ease of use and low cost, especially for large donor sites (72). These dressings are semi-Open. There is egress of fluid and bacteria through the fine mesh; as the dressing dries, fibrin from the wound bed causes temporary bonding of the dressing to the wound (30,70).

Split thickness skin graft donor sites have been treated with open or closed dressings.(59) The open technique of donor dressing has been long abandoned in favour of the closed method since occlusive dressings have shown better results with shorter healing time, superior quality of the regenerated epithelium and more patient comfort. It has also shown the added advantage of protecting the donor site from desiccation, mechanical trauma and contamination.(59) A more traditional method is dressing the donor site with a fine mesh gauze beneath a closed absorbent

dressing. The gauze may be dry but is usually impregnated with bismuth, scarlet red or petroleum jelly. Though the gauze initially provides a moist environment it gradually becomes desiccated and an eschar forms which acts as a mechanical barrier and impairs cellular migration. However these dressings can also become permeable to bacteria if wound exudate soaks through the entire thickness of the dressing. Furthermore movement of the donor site dressing produces shearing forces that may cause pain, dislodge the dressing and impair the migration of epithelial cells. At the time of removal, the dressing is adherent and liable to damage the fragile regrown epithelium(17,71).

Studies have shown that a moist environment promotes healing in a partial thickness skin loss. The use of polyurethane film, a semi permeable dressing maintains a moist environment allowing diffusion of oxygen and water vapour while providing a barrier to the passage of wound exudates. It has claimed to reduce the healing time and donor site pain. However it has proved difficult to use as wound exudate collects beneath the film and is liable to leak out(17,71). Other experiments have used silicon gel sheets, also a semi permeable dressing with similar results.

BIOBRANE

Biobrane is a biocomposite of ultrathin semipermeable silicone membrane bonded to a flexible knitted nylon fabric. The two layers are

covalently bonded to porcine collagen peptides, which increase wound adherence. The flexibility and stretch of Biobrane enable its application to many different donor site areas; its high water vapor permeability minimizes fluid collections, and the ability to see through it permits ongoing evaluation of the wound. A limited number of studies comparing Biobrane with more conventional donor site dressings have been showing with mixed results.

DUODERM

Duoderm is an oxygen-impermeable, hydrocolloid dressing, is being used extensively for treatment of dermal ulcers, burns and minor abrasions, and as a dressingfor skin graft donar sites. It is composed of an outer layer of polyurethane foam that is impermeable to oxygen and water and an inner layer of hydrocolloid polymer complex that is occlusive and hydrophilic. Its oxygen impermeability has been shown to promote the rate of epithelialization and collagen synthesis and to decrease the pH of wound exudate, thus potentially reducing bacterial counts (23,57,). Because the dressing does not adhere to open wounds, it neither damages newly formed epithelium nor causes irritation or pain during dressing changes. The results of studies comparing Duoderm with conventional fine mesh gauze have confirmed its potencial clinical usefulness for skin graft donor sites with certain reservations (59,71,14).

OMNIDERM

Omniderm is a polyurethane Film , which is transparent, hydrophilic and highly permeable to water.

XEROFORM

A popular fine mesh gauze, inexpensive,easy to use and associated with a low infection rates. Results also confirm that reepithelialization of donor sites covered with xeroform occurs in about ten days. However, Xeroform was more painful as a dressing than Biobrane or Duoderm . Patients complain most when the rolled gauze bandage was removed on the first postoperative day. Coagulum caused the Xeroform to stick to the gauze and removal was quite painful.

OPSITE

It is a polyurethane dressing. These dressings will provide a seal, thereby eliminating the risk of external infection as well as diminishing pain. In addition, these dressings have no pro-healing properties.

TEGADERM

Absorbent Clear Acrylic Dressing is a moisture-retentive, absorbent dressing which combines the benefits of highly absorbent dressings such as hydrocolloids, foams, alginates and hydrofibers with the transparency of thin film dressings.

HYDROCOLLOIDS

These promote healing, leaving donor sites soft, pink, supple and suitable for reharvesting, if necessary, within eight days (Doherty et al, 1986). They are simple to change and cause minimal disruption to new epithelium. The patient experiences increased comfort and healing rates and decreased pain. However, hydrocolloids can be costly and time consuming and require many dressing changes due to leakage, which can be offensive smelling and distressing for the patient.

CALCIUM ALGINATES

Attwood (1989) suggested these are inexpensive dressings, which increase haemostasis, comfort, speed of healing and quality of the new skin. They have been used quite widely for donor sites. They do have problems with drying out and adhering to the wound surface.

SOFT SILICONE WOUND CONTACT DRESSING (MEPITEL)

This has not been used widely for donor sites, mainly due to cost, which is significantly more than that for alginates or hydrocolloids. However, Mepitel is easier to remove and does not shed fibres into the wound. It has also been found to stop donor-site slippage (Wilkinson, 1997).

FOAM DRESSINGS

There is a lack of research in the use of foam dressings to manage donor sites but their absorbency and comfort suggests they might have a place in this area.

Wilkinson (1997) supports this and suggests that foams have a low adherence at the wound interface, can retain significant amounts of exudate and can be cut to size.

HYDROFIBRE DRESSINGS

Successful use of these dressings (Aquacel) and those impregnated with silver on donor sites have been reported (Barnea et al, 2004; Perlov et al 2001).

TISSUE ENGINEERED WOUND MATRIX COVERAGE

The advantage of the use of Wound Matrix dressing is that the dermis lost with the STSG is replaced with Wound Matrix as it incorporates. The Tissue Engineered Wound Matrix also contains all the active proteins and matrix components of dermis which can increase the rate of re-epithelialization. In addition, the use of a wound matrix results in immediate wound closure thereby protecting the remaining dermis.

Recent experiments have shown that biological dressings create the most physiological interface between the wound surface and the

environment and permit the body's reparative and immune system to function most efficiently.

Experiments have been carried out using porcine xenografts, amniotic membranes and collagen sheets. However both have shown poor results. Porcine xenografts showed a large percentage of abnormal healing due to sub epithelial incorporation and rejection and the amniotic membrane dressings showed a delayed healing. (58). Collagen sheets have been used as a donor site dressing which comes close to being called an ideal donor site dressing.

During the last decade, various new dressing materials developed, like calcium alginate, hydro-colloid membranes and fine mesh gauze. These have a disadvantage in that they become permeable to bacteria. Biological dressings like collagen on the other hand, create the most physiological interface between the wound surface and environment, and are impermeable to bacteria(52).

Collagen dressings have other advantages over

* conventional dressings in terms of ease of application and being natural non-immunogenic, non-pyrogenic, hypo-allergenic, and pain-free.(41).

ROLE OF HAEMOCOAGULASE WITH COLLAGEN SHEET IN SSG DONOR SITE

In the recent years, patient census has increased four fold.

Rapid relief of pain is essential for early ambulation and discharge of patients.

The objective was a cost effective measure to aid pain relief and good reepithelisation of the donor site.

INITIATIVE

Increasing patient census

Need for short hospital stay

Upgraded comfort

Reduction of donor site morbidity

HAEMOCOAGULASE

Haemocoagulase is isolated from bothrops atrox or botrops jarraca (venoumous snake of South America). It is a C type lectin like protein.It has Thrombin like action (rapid conversion of fibrinogen to fibrin) and also has Thromboplastin like enzymatic activity(activates factor x) and

reduces capillary bleeding. It is available as a readily usable solution (botroclot).

Collagen

Proteins are natural polymers and make up almost 15% of the human body. The building blocks of all proteins are amino acids. Collagen is the major protein of the extracellular matrix (ECM) and is the most abundant protein found in mammals, comprising 25% of the total protein and 70% to 80% of skin (dry weight). Collagen acts as a structural scaffold in tissues. The central feature of all collagen molecules is their stiff, triple-stranded helical structure.1 Types I, II, and III are the main types of collagen found in connective tissue and constitute 90% of all collagen in the body.

Previously, collagens were thought to function only as a structural support; however, it is now evident that collagen and collagen-derived fragments control many cellular functions, including cell shape and differentiation, migration, and synthesis of a number of proteins.

Findings suggest that cell contact with precise extracellular matrix molecules influence cell behavior by regulating the quantity and quality of matrix deposition.

Type I collagen is the most abundant structural component of the dermal matrix; migrating keratinocytes likely interact with this protein.

Collagenase (via formation of gelatin) may aid in dissociating keratinocytes from collagen-rich matrix and thereby promote efficient migration over the dermal and provisional matrices. Cellular functions are regulated by the ECM. The information provided by ECM macromolecules is processed and transduced into the cells by specialized cell surface receptors. Evidence demonstrates that the receptors play a major function in contraction of wounds, migration of epithelial cells, collagen deposition, and induction of matrix-degrading collagenase. Although keratinocytes will adhere to denatured collagen (gelatin), collagenase production is not turned on in response to this substrate. Keratinocytes have been known to recognize and migrate on Type I collagen substratum, resulting in enhanced collagenase production.

Collagen plays a key role in each phase of wound healing.

1. Stops bleeding (Hovig et al 1968).

2. Helps in wound debridement by attracting Monocytes (Postlewaithe and Kang 1976).

3. Provides a matrix for tissue and vascular growth (Kleinman et al 1981).

4. Attracts fibroblasts and helps in directed migration of cells (Dunn and Ebendal, 1978).

5. Binds with Fibronectin, which promotes cell binding (Kleinman et al, 1981).

6. Supports growth (Morykwas et al 1989), differentiation and migration (Emerman and Pitelka,1977) of keratinocytes.

7. Helps in deposition of oriented and organised fibres (Doillion et al, 1984) which increase the integrity of the tissue.

The use of collagen dressing has been found to inhibit the action of metalloproteinases.[74] Collagen is a biomaterial that encourages wound healing through deposition and organization of freshly formed fibres and granulation tissue in the wound bed thus creating a good environment for wound healing. [50]

Collagen sheets, when applied to a wound, not only promote angiogenesis, but also enhance body's repair mechanisms.[52,41] While acting as a mechanical support these reduce oedema and loss of fluids from the wound site, along with facilitation of migration of fibroblasts into the wound and enhancing the metabolic activity of the granulation tissue.[52,48] Moreover, it is easy to apply and has the additional advantage of stopping bleeding. (10)

BIOLOGICAL ADVANTAGES OF COLLAGEN SHEET (28):

Collagen sheets are non-inflammatory

They facilitate migration of fibroblasts and microvascular cells

They help in the synthesis of neodermal collagen matrices

They have low antigenicity

They have minimal biodegradation

They are non-toxic

They help in minimising scarring

PHYSIOLOGICAL ADVANTAGES OF THE COLLAGEN SHEETS :

They are impermeable to bacterial migration

They modulate fluid flux from the wound

They are elastic, soft, and supple, and therefore fit all contours

They have good tear strength

They have enough strength to be peeled off the wound.

The most comprehensive care of donor site wounds was described by Fowler and Dempsey (1998) who advised:

* Administer analgesia regularly

* Aid pain management by elevation and/or immobilisation of the donor site area

* Observe and act upon signs of excess bleeding and pain from infection that is unrelieved by analgesia and pyrexia

* Reassure the patient regarding wound odour which may cause embarrassment

* Only remove the dressing before the agreed date if it is contaminated.

* Review the initial primary dressing choice and change to an antimicrobial dressing if appropriate

* Ensure that the choice of dressing is practical and appropriate for the patient

* Allow the primary wound contact layer to separate spontaneously

* Classify a donor site as healed only if the primary contact layer is removed without pain leaving a dry, re-epithelialised surface

* Ensure the patient has appropriate advice regarding aftercare.

* Advice for patients about the donor site wound

* Patients need to be reassured that once the wound is healed it is appropriate for them to take over their own aftercare. The donor site wound will appear dry, very pink and possibly itchy when it has recently healed.

* Patients will often be wary because it does not appear the same as the rest of their skin and will wonder whether this is normal and whether the wound has healed.

* Patients should be given the following advice:

Although the wound may be itchy it is best not to scratch as the new skin is fragile and may be broken by scratching. Regular application of emollients may help. The skin should be washed using a non-perfumed soap and then patted dry rather than rubbed. (Fowler and Dempsey, 1998).

MATERIALS AND METHODS

Conventional closed dressing with Sterile Vaseline gauze and Combination dressing with Haemocoagulase and sieved Collagen Sheet are applied to different subsets of patients at the donor site following harvesting of split skin graft.

Permission was obtained from ethical committee for this study

COMPARISION of Pain at the donor site, Ambulation, Reepithelisation of donor site wounds after 2 weeks was done.

INVESTIGATION

Blood haemoglobin

Blood sugar and urea

Serum protein and creatinine

Blood group

Wound swab for culture and sensitivity

TREATMENT OPTIONS

1. CLOSED DRESSING with Vaseline impregnated gauze application over the donorsite.

2. OPEN DRESSING with Haemocoagulase and sieved Collagen Sheet application over the donorsite

INCLUSION CRITERIAS

All patients are given vitamin and protein supplements and appropriate antibiotics to minimize systemic factors interfering with healing. Donor site raw areas of 10x 10cm to maximum of 25x 40 cm was included for both groups

EXCLUSION CRITERIAS

Patients with Diabetes mellitus, Hypoproteinemia, Anemia were excluded from study.

Donor sites after harvesting of thin split skin graft excluded from study.

Large donor site raw areas were excluded from study in both groups.

PERIOD OF STUDY

NOVEMBER 2009 TO JAN 2012'.

Study conducted on two groups of fifty patients. .

GROUP I-control group had conventional closed dressing while

GROUP II- the study group had haemocoagulase with collagen sheet dressing. The study period was November 2009 – January 2012 Closed dressing -50 cases Haemocoagulase with moist collagen sheet - 50 cases.

PROCEDURE

GROUP I- The conventional closed dressing is by sterile vaseline gauze to the donor site with bulky gamjee pad and bandage

GROUP II- 5 – 10 drops of the haemocoagulase topical solution is applied to the donor site.

Applied haemocoagulase solution is gently smeared over the donor site.

Sterile moist collagen sheet is sieved and applied to the donor site after checking haemostasis.

Sieving the moist collagen sheet helps in the drainage of the exudate and air bubbles.

The collagen sheet on the donor site is allowed to dry.

Patient is shifted to the post operative ward only after adequate drying of the collagen sheet. Extra care taken to prevent displacement of collagen sheet during the shifting maneuvre.

POST-OP ASSESSMENT

The pain experienced at the donor site is graded as per the universally followed pain scores and recorded at 48 hours post op.

Time of starting ambulation of the patient is recorded post operatively and the day of significant pain free ambulation is noted in both groups.

Wound reviewed daily in the combination dressing and closed dressing group for soakage of dressing.

The separation of the collagen sheet from the donorsite and loosening of the closed dressing is observed for healing of donorsite & the re epithelisation of the wound is assessed.

ANALYSIS

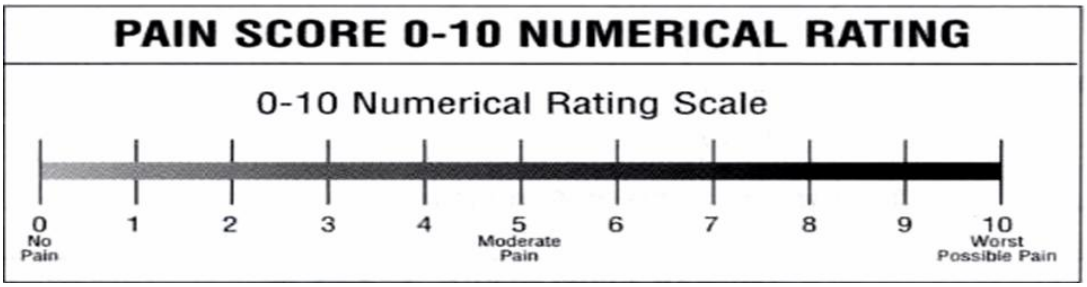
Pain assessed as per pain score at 48 hrs

Early ambulation assesed

Daily review of the wound

Re epithelisation of wound assesed on day 15, 21

NUMERICAL RATING SCALE (NRS)



FACES RATING SCALE (FRS)

The Numerical rating scale for pain is graded 0-10 and is useful for educated patients.

No pain is grade 0 ,moderate pain is graded as 5 and worst possible pain is grade 10.

The Wong baker face scale is helpful for uneducated patients with use of pictorial representations of the painful facies.

OBSERVATION & RESULTS

PAIN

In our study, among the patients the who had the conventional donor site dressing with meshed Vaseline gauze had a median pain score of 5 observed in 23 patients. Minimum pain score in this group was 3 noted in 2 patients. maximum pain score was 6 experienced in 4 patients. Pain score of 4 was noted in 21 patients.

In comparision the combination dressing group with haemocoagulase and collagen dressing had different results . the median pain score was 2 experienced in 27 patients. Minimum pain score was 1 noted in 6 patients. Maximum pain score noted in the collagen dressing group was 4 observed in 4 patients. The remaining 13 patients experienced a pain score of 3. Pain was drastically reduced in the collagen dressing patients.

AMBULATION

Since the pain score was high in the closed dressing subset of patients, it limited their mobilization and 22 patients were ambulant only on postoperative day 3. Only 10 patients were ambulant on the 2nd post operative day. The remaining 18 patients ambulated well only on the 4th postoperative day.

Due to the decreased pain in the collagen dressing for the donor site patients ambulated early and 27 patients were ambulant from 1 st postoperative day.

Subsequently 21 patients were ambulant on 2nd post operative day. The remaining 2 patients ambulated on the 3rd postoperative day.Early ambulation was noted in the in patients with the collagen dressing

RE EPITHELISATION

Donor site reepithelisation was assessed in the closed dressing by the loosening of the dressings average time taken for the donorsites to reepitheliase was 20 -23 days. Due to complications of donor site infection the donor site healing extended to 29 -31 days in about 6 patients.

Donor site reepithelisation was noted between 15-17 days in the collagen dressing group. In 2 patients donor site healing was delayed to 21-23 days due to donor site infection which was treated by conservative methods due to the ease of inspection of donor site and had the advantage of early identification of donor site complications. In 1 patient there was displacement of collagen sheet from the donorsite and it was converted to closed dressing and excluded from study. The healing time noted in that patient was 23 days.

COST FACTOR ANALYSIS

The cost for the conventional closed dressings was Rs .150 inclusive of the over padding needed in review period. The cost factor for application 25x40 cm moist collagen sheet to the donor site was Rs 450.

DONOR SITE COMPLICATIONS

Infection

Donor site infection was noted in 6 patients of the closed dressing group. It was managed with conservative dressings with framycetin. donorsite dressings on periodic review showing excessive soakage with foul smell were opened end wound swabs taken

Donor site infection noted in 2 patients in the collagen dressing group, conservative e dressings done to treat with the infection in these patients.

Collagen Displacement-

1 patient in the study group had shearing of collagen sheet when applied to donor site in the postoperative period. Wound was cleaned and closed dressing applied and patient was excluded from the study.

Donor site dressing problems

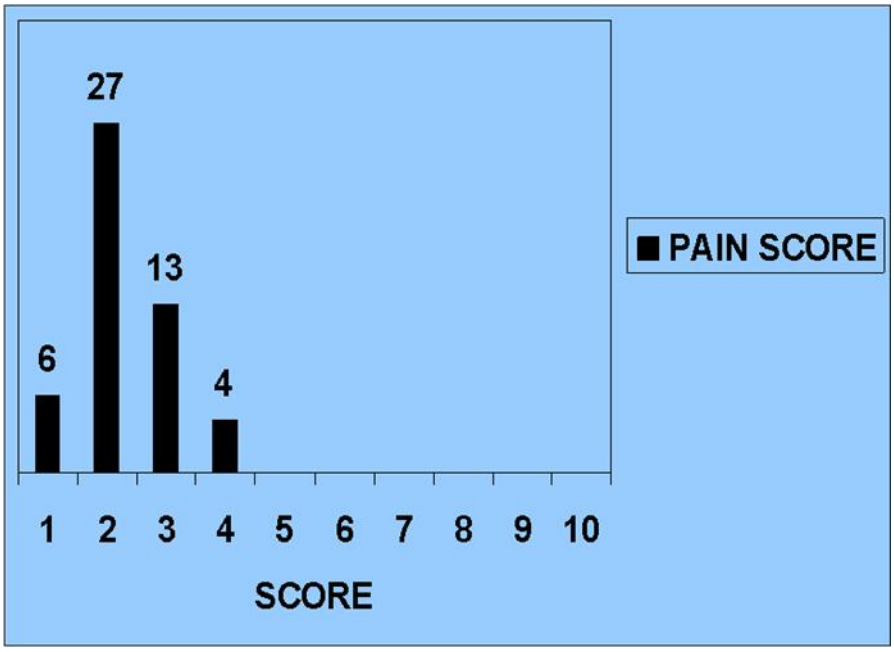
DRESSING SOAKAGE AND INFECTION

The donor site dressing soakage was more in the closed dressing patients and over padding done. This had the disadvantage of increased bulk of the dressing. Malodour present due to dressing soakage was promptly managed to rule out donor site infection. The increased bulk of the dressing due to over padding and the seepage of exudates from dressing to the garments produced a major discomfort in wearing the garments in patients with closed dressing. The combination dressing with hemocoagulase and collagen dressing did not have disadvantage of soakage of dressing nor bulky dressing. The patients had increased comfort in wearing the garments which boosted the morale of the patients and encouraged early ambulation. Though the patients had initially apprehensions due to the exposed raw area at the donor site, patients were counseled and in the post operative period direct visualization of the healing donor sites lessened their anxiety. The reduced pain, comfort of dressing and advantage to wear the garments early made patients who were subjected to multiple grafting procedures and treated with both methods of dressing opt for the combination dressing in subsequent procedures.

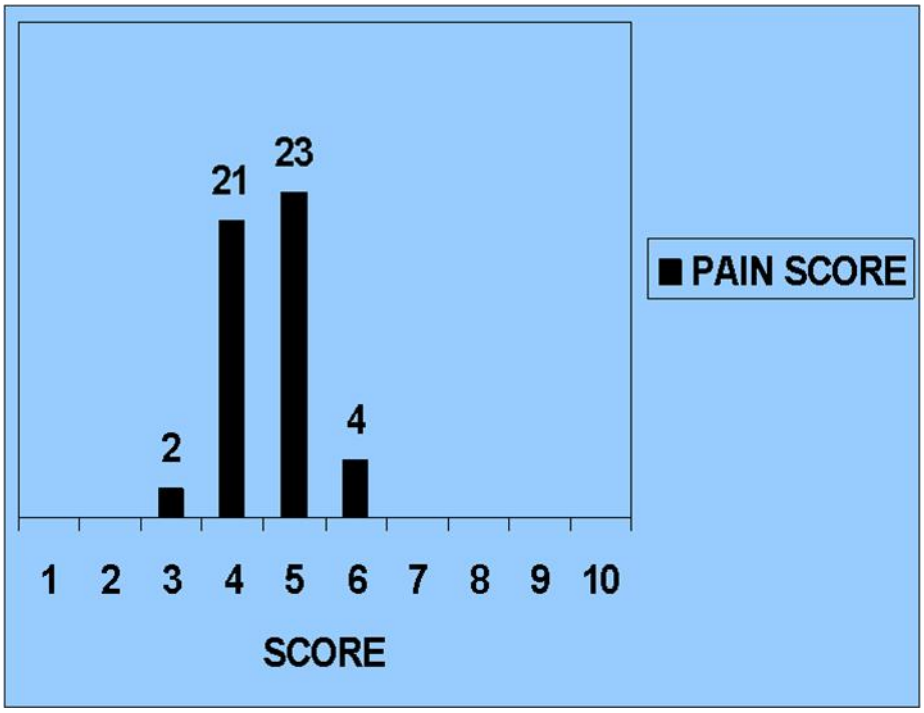
OBSERVATIONS

	COLLAGEN DRESSING	CLOSED DRESSING
PAIN SCORE	2	5
AMBULANT ON	1st POD	3rd POD
REEPITHELISATION	15-17 DAYS	20-23 DAYS
COST FACTOR	RELATIVELY EXPENSIVE	LESS EXPENSIVE

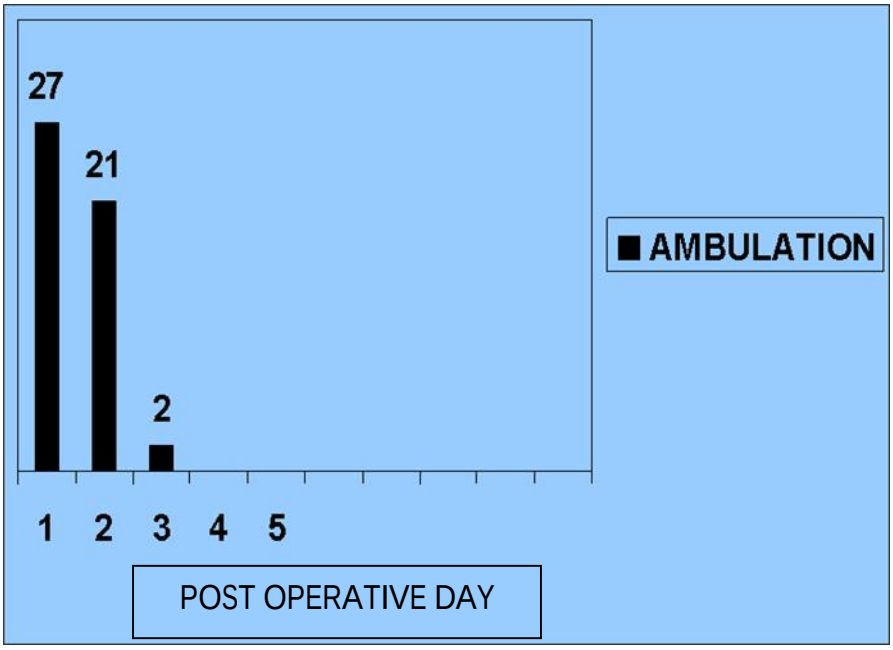
COLLAGEN DRESSING



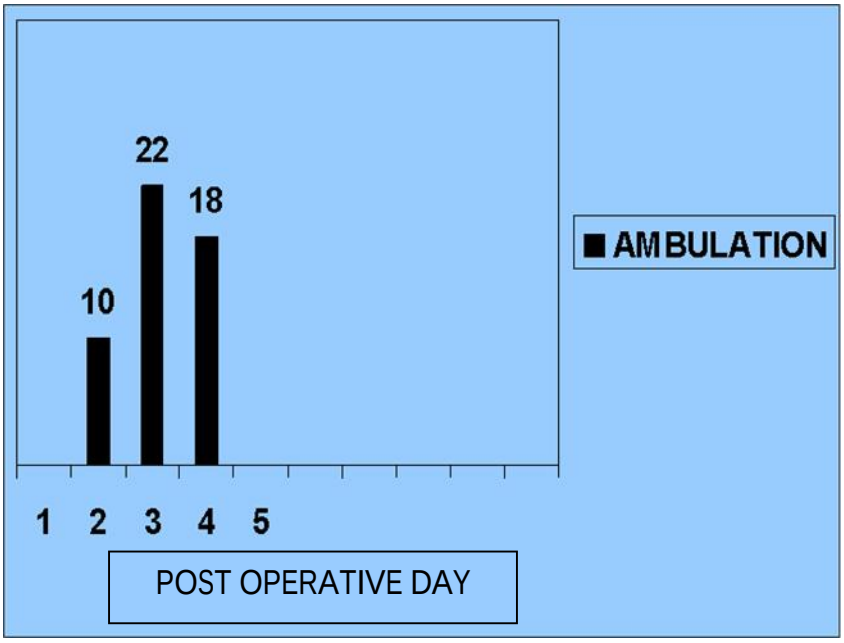
CLOSED DRESSING



COLLAGEN DRESSING



CLOSED DRESSING



Intensity of pain was drastically reduced in the combination treatment group treated with hemocoagulase and collagen sheet. This facilitated early ambulation from the very next day.

Complete epithelisation was found in all cases. Eventhough the procedure was more expensive, it will be cost effective in the longrun as it helps in higher turnover of patients with better acceptability. Shearing of collagen sheet on the posterior thigh donor sites is common and may lead to significant donor site morbidity.

Patients who were subjected to multiple grafting procedures felt collagen dressing was better and comfortable.

DISCUSSION

Split-thickness skin grafting (STSG) is a frequently used reconstructive technique but is associated with variations in practice. Rakel et al (1998) in the review of the literature found a transparent film to be the best dressing for the care of STSG donor sites. This review of 33 studies found that transparent film was associated with one of the fastest healing rates, a smooth epithelialized surface, a low infection rate, the least amount of pain and minimal cost.

Numerous controlled studies in the last 50 years have established that moist wound healing is the best evidence based practice. Dried wound tissue is more prone to complications such as infection, scarring, pain and prolonged healing. The goal of treating skin graft donor sites is to promote healing while minimizing the risk of introducing new complications and pain to an already traumatized patient.

Essentially, the wound was left open to scab, which is contradictory to the best evidence-based practice of today, that of moist wound healing. In recent years, much has been published highlighting the benefits of moisture-retentive dressings in treating donor sites.

Moisture-retentive dressings that have been used include hydrocolloids, foams, and transparent thin film dressings, alone or in combination with absorbent materials such as alginates, hydrofibers or

gauze. While hydrocolloids and foams provide the needed absorbency, they must be removed whenever wound inspection is required, increasing treatment cost and the risk of traumatizing the wound. Thin film dressings allow for wound visualization, but usually fail to contain the drainage for more than 24 hours, even when used secondary to other absorbent dressings (which also negates the benefit of transparency).Tegaderm™, Absorbent Clear Acrylic Dressing is a moisture-retentive, absorbent dressing which combines the benefits of highly absorbent dressings such as hydrocolloids, foams, alginates and hydrofibers with the transparency of thin film dressings. Recent published work indicates that this dressing provides excellent results with skin donor sites2,3.

As early as 1962, Winter [15] showed that moist wounds healed faster than wounds left to dry out. This observation has led the care of skin graft donor sites away from the conventional dry gauze dressings toward the semi-occlusive or occlusive dressings. Although these occlusive dressings provide moist environments for wound healing, there has been concern that occlusion of wounds would lead to increased infection [16-181. How- ever, Hutchinson and McGuckin [19], in a review of 29 donor site studies, showed an infection rate of only 2.7% in 594 occluded wounds versus an infection rate of 6.4% in 360 conventionally dressed wounds (Figure 1). In a recent study on donor site wound healing, 30 burn patients with skin graft donor sites were randomized to receive either an

occlusive (DUODERM) or conventional gauze dressing on their wounds [2]. Wounds in both groups were colonized with bacteria; however, only conventionally dressed wounds became infected (Table I).

Bacteria were pre- sent intraoperatively in 9 of 14 (64%) hydrocolloid- treated sites and in 5 of 16 (31%) conventionally treated sites.

Moist wound healing is not a new idea and providers continue to strive to find the optimal treatment that provides this ideal, moist environment. George Winter is often referenced as a pioneer among wound-care practitioners because of his work in the early 1960s that proved wounds re-epithelialize quicker in a moist environment (Winter, 1963). It is indeed the epithelialization process on which we focus when treating the skin graft donor site. Historically, the most popular way of treating skin graft donor sites is the dry open technique using either scarlet red or petrolatum bismuth dressings. A heat lamp or air blowing device is then placed over the area to dry out the donor site and form a scab. This process is commonly perceived as a painful treatment so investigators sought a pain free dressing that allowed for absorption of the excessive exudate as well as hemostasis. There are even reports of placing wax paper over the area thereby protecting the nerve endings from the pain in an attempt to heal the superficial wound (Weeter, 1952).

Utilization of a moisture vapor permeable transparent dressing yielded freedom from pain, early healing, and less bulky dressings, however, post-operative leakage from the site required frequent dressing changes on the fragile tissue (James & Watson, 1975). The aim became marrying the advantages of painless and moist wound healing with the concept of absorption. Epinephrine applied to the fresh donor site was proposed as a solution to excessive sanguinous exudate, but there was still dressing slippage leaving the donor site exposed (Pontén & Nordgaard, 1976). In addition, the concern of infection with occlusive dressings was raised, but Birdsell, Hein, and Lindsay (1979) found no infections in the 100 patients studied with occlusive dressings. Salisbury, Bevin, Dingeldein, and Grisham (1979) investigated polyurethane foam but found that the histologic examination of the pig's skin showed no evidence that the foam made a difference in healing time despite the dressing's painless removal. The idea of hemostasis was achieved utilizing an alginate dressing, which also provided the absorption component yet the dressing still required changing prior to complete healing, resulting in a painful event (Groves & Lawrence, 1986). Attwood (1989) continued the use of alginate and demonstrated a decrease in healing time compared to paraffin gauze dressings.

In the 1990s, the quest continued with the introduction of Biobrane as a cover over the donor site, yet its cost and rate of infection were too much to accept when Xeroform (a bismuth petrolatum-impregnated

nonstick antimicrobial gauze) continued to be cheap and easy despite the advantage of reduced pain with Biobrane (Feldman, Rogers, & Karpinski, 1991). The hydrocolloid emerged as a winner because it had a high rate of absorption, showed fewer infections, and had more rapid healing with acceptable leakage (Smith, Thomson, Bolton, & Hutchinson,1993). By 1995, Griswold et al. (1995) evaluated a new dressing that was made from type I bovine collagen. Of no surprise, this dressing indeed healed faster than Xeroform and was less painful, however, the collagen had to be inspected and the dressing changed on days 3, 5, and 7 Patients with collagen dressings are found to have only minimal to moderate pain in the entire post operative period and during the first dressing. In these patients analgesic requirement is reduced and early mobilisation can be done. Thus the major advantage of using collagen as a donor site dressing is decreased pain.

The collagen sheet once adherent to the wound has low friction between the wound surface and dressing and this has made it suitable for awkwardly sited donor sites. (Gupta RL, Jain RK, Kumar M, et al).

Also once applied it does not require a bulky dressing which would hamper mobilisation, or require a change of dressing as there is no soakage of the dressing due to wound exudate.

The burn literature continues to examine more donor-site dressings than any other discipline and Duinslaeger, Verbeken, Vanhalle, and

Vanderkelen (1997) evaluated cultured allogeneic keratinocyte sheets. These sheets accelerated healing compared with transparent dressings but were quite expensive.

A systematic review in 1998 answered the question of cost but started with the various options for dressing selection on the donor site.

A review performed by Rakel et al. (1998) found that in the last 40 years the transparent dressing still reigns because of its association with faster healing rates, smooth epithelialized surface, low infection rates, less pain, and minimal cost.

Despite the increasing array of products available and this review, the most commonly used dressing was the calcium alginate even though it is not rated high in dressing performance (Lyall & Sinclair, 2000). The most important item from the survey was patient comfort. The gold standard by which other dressings are now being measured moved away from the transparent dressing to the calcium alginate but the alginate fell short in comparison with the silicone-coated polyamide net (Mepitel; O'Donoghue, O'Sullivan, O'Shaughnessy, & O'Connor, 2000).

Although Mepitel is virtually nonstick and can be left in place for days at a time, it requires secondary dressings to absorb moisture. Chitosan is a derivative of shrimp exoskeleton and has the ability to rapidly clot blood. The chitosan is being impregnated into gauze

dressings and used in the field during times of war. This mixture is also hypoallergenic and has natural anti-bacterial properties. With such promise, it was only a matter of time that this dressing was evaluated on the donorsite. Stone, Wright, Clarke, Powell, and Devaraj (2000) were impressed with the re-epithelialization rates and regeneration of nerves within the vascular dermis, but the use of chitosan was limited because of availability. The foray into these often-expensive and limited dressings prompted some to ask whether the dry open technique was indeed better. The limitation of this technique due to pain, already detailed, led to a modification.

The donor site was still left open but under moist conditions utilizing the application of Moist Exposed Burn Ointment. Although the full action of the ointment is unknown, Atiyeh, Ghanimeh, Kaddoura, Ioannovich, Al-Amm (2001) determined that even in their limited evaluation, there was some promise because of the cosmetic outcome. At this point, it seems there can be no more new and original ideas in the arena of donor-site care but a novel topical application must be explored despite its obvious limitations. Egg membrane as a biological dressing was evaluated by Yang, Chuang, and Tsay (2003). The dressing indeed provided pain relief, protection, and healing, and was low cost, yet the size of the dressing was limited and the feasibility was narrow. Despite continued examination of foam, alginate, collagen, and even cellulose, there were not many discoveries but rather the continued confirmation

that the alginate and transparent cover were supreme. Then, a new absorbent transparent dressing hit the wound-care market and was immediately evaluated by Terrill, Goth, and Bailey (2007) on donor-site wounds. Terrill et al. found the dressing to be cost comparative and easy to apply. The donor-site scars with this dressing were less red and itchy, flatter, and softer. The best attribute of the dressing, of course, was pain-free healing. The 3M Tegaderm Absorbent Clear Acrylic Dressing is a moisture-retentive dressing that is absorbent yet transparent. The product is designed to be changed every 3–5 days per manufacturer guidelines yet donor sites on average take up to 14 days to heal completely. Even with the benefit of pain-free dressings, the patient still has to endure two to three dressing changes until healing has been achieved.

In our study significant pain reduction, early ambulation, comfortable dressing, similar to the study of Collagen Dressing in The Management of Donor Site of Split Thickness Skin Grafts (P Halankar*, D Cunha-Gomes**, C Chaudhari*) good reepithelisation, and early discharge of the patients with signs of good healing was noted in the collagen dressing. P Halankar*, D Cunha-Gomes**, C Chaudhari* , at Bombay Hospital and Medical Research Centre, studied a group of 30 patients were included in this study with 21 males and 9 females ranging from age 18 to 72 years. All patients required split thickness skin grafts of approximately 100-250 cm2 in area to provide cover for various indications . In the group all patients tolerated the collagen dressing well

and there was no allergic reaction. In the early postoperative period on assessment of donor site pain to touch and pressure, 2 patients in the group had no pain, 23 rated the pain as minimal while 7 patients assessed the pain as moderate and tolerable. There was no complaint of severe pain and none of the patients required additional analgesics for donor site pain. Once the patients were mobilized by the third postoperative day they were assessed again for pain while walking. In the patient group 21 patients assessed the pain as minimal, 7 assessed the pain as moderate and 2 as severe. The 2 patients who had severe pain on walking also had severe pain on touch and pressure and required additional analgesics to relieve them of the donor site pain. All other patients had no analgesic requirement for the donor site.

In 2 patients soakage of wound exudate was seen on the fifth and eighth post operative day respectively. These were the two patients in whom there was significant donor site pain. In both patients the donor site dressing was foul smelling and the wound was covered with purulent discharge with degradation of the collagen sheet. The infection was limited to the donor site with no evidence of cellulitis of the surrounding skin or fever. The infected sites were redressed with framycetin impregnated paraffin gauze. In both patients the wounds were redressed after forty-eight hours by which time pain had subsided. On the fourteenth post operative day the donor site dressings were soaked in saline and easily removed with no pain in 5 patients, while 18 and 7 patients had minimal and moderate pain respectively. None of them

complained of severe pain. In the group 24 patients showed 100% reepithelialisation, 4 showed between 90-100%, while the two with infected donor sites had < 90% reepithelialisation. In the group 1 patient had a haematoma beneath the collagen dressing but there was complete re-epithelialisation beneath the haematoma. On late follow up of 26 patients, 2 showed hypertrophic scarring of the donor site.

In our study the median pain score was 2 in the collagen dressing compared to the increased pain score of 5 in the conventional closed dressing group. Patients were ambulant from postoperative day 1 with the collagen dressing, while patients with the bulky closed dressing were ambulant from the third postoperative day.

In our study cost factor analysis increased expenditure towards collagen dressing, but the above advantages help in rapid turnover of patients with minimal donor site morbidity which is the need of the hour in recent treatment protocols in management of rawareas. The advantage of direct review of the donorsite wound in the collagen group helps in early identification of problems and also manage the wounds properly and salvage them from becoming full thickness wounds which will increase donor site morbidity.

Skin graft donor sites in burn patients warrant intense treatment and optimal wound-management techniques. An ideal dressing method prevents dehydration and infection while facilitating wound healing. Dressings should be easy to apply and require minimal care.

CONCLUSION

Haemocoagulase with Collagen sheet application for donor site have the following advantages.

- Less pain over the donor site compared to the conventional closed dressing with Vaseline gauze.
- Early ambulation due to reduced pain after the application of collagen sheet to the donor site.
- Reepithelisation complete for most patients and time of reepithelisation is similar to the standard expensive dressings for the donor site.
- Inspection of the donor site wound can be done easily and complications can be recognized early.
- A comfortable Dressing due to the decreased bulk of dressing and ease to wear the garments over the dressing.
- Less complications and better outcome compared to the conventional closed dressing.

BIBLIOGRAPHY

1. Albini A, Adelmann-Grill BC. Collagenolytic cleavage products of collagen Type I as chemoattractants for human dermal fibroblasts. Eur. J Cell Biol. 1985;36(1):104–107

2. A1arezO, . M., Mertz, P. M., and Eaglestein, W. H. The effect of occlusivedressings on collagen synthesis and re-epitheli.alization in superlicial wounds. J. Surg. Res., 1983, 35. 142-148.

3. Altemeier W, Burkerts F, Pruitt B, Sandusky W. Manual on Control of Infection in Surgical Patients, 2nd ed. Philadelphia: JB Lippincott Company, 1976: 29-30.

4. Brown CL, Curtsinger LJ, White M, et nl. Enhancement of epidermal regeneration of biosynthetic epidermal growth factor. J Exp Med 1986; 163: 1319-24.

5. Biltz, H., Kiessling, M., and Kreysel, H. W. Comparison of hydrocolloid dressing and saline gauze in the treatment of skin graít donor sites. In: An Environment for Healing: The Role of Occlusion. Edited by T. J. Ryan. Pp. 125-128. London: Royal Society of Medicine,1985.

6. Brady, S. C., Snelling, C. F. T., and Chow, G. Comparison of donor site dressings. Ann. Plast. Surg., 1980, 5: 238-243.

7. Burton JL, Etherington DJ, Peachey RD. Collagen sponge for leg ulcers. Br J Dermatol. 1978;99(6):681–685

8. Bennett RG. The debatable benefit of occlusive dressings for wounds. Dermatol Surg Oncol 1982; 8: 166-7.

9. Champsaur, A., Amadou, R., Nefzi, A., and Marichy, J. Use of Duoderm ondonor sites after skin grafting. A comparative study with Tulle-gras. In: BeyondOcclusion: Wound Care Proceedings. Edited by T. J. Ryan. Pp. 127-131. London: Royal Society of Medicine, 1988.

10. Chung J, Wang XQ, Lindberg FP, Frazier WA. Thrombospondin-1 acts via IAP/CD47 to synergize with collagen in alpha2beta1-mediated platelet activation. Blood 1999;94:642-8.

11. Doillon CJ, Silver FH. Collagen-based wound dressing: effects of hyaluronic acid and fibronectin on wound healing. Biomaterials. 1986;7(1):3 8.

12. Doillon CJ, Whyne CF, Berg RA, Olson RM, Silver FH. Fibroblast-collagen sponge interactions and spatial deposition of newly synthesized collagen fibers in vitro and in vivo. Scan Electron Microsc. 1984;(Pt 3):1313–1320

13. Doillon CJ, Silver FH, Olson RM, Kamath CY, Berg RA. Fibroblast and epidermal cell-Type I collagen interactions: cell culture and human studies. Scanning Microsc. 1988;2(2):985–992.

14. Eriksson G, Eklund AE, Kallings LO. The clinical significance of bacterial growth in venous leg ulcers. Stand J Infect Dis 1984; 16: 175-80.

15. Evans AJ. Treatment of burns today. Proc R Sot Med 1971: 64: 21-2

16. Falanga V. Classifications for wound bed preparation and stimulation of chronic wounds. Wound Repair Regen. 2000;8(5):347–352.

17. Feldman DL. Which dressing for split-thickness skin graft donor sites? Ann Plast Surg 1991; 27: 288

18. Friedman, G. D., Capozzi, A., and Pennisi, V. R. Care of the split thickness skin graft donor site. J. Trauma.,1974, 14: 163-167.

19. Freshwater MF, Chi Tsung Su, Hoopes JE. A Comparison of Polyurethane Foam Dressing and Fine Mesh Gauze in The Healing of Donor Sites. Plastic and Reconstructive Surgery 1976

20. Fantone JC, Ward PA. Role of oxygen-derived free radicals and metabolites in leukocyte-dependent inflammatory reactions. Am J Path01 1983; 107: 397.

21. Griswold JA, Grube BJ, Engrav LH, et al. Determinants of donor site infection in small burn grafts. J Burn Care Rehabil 1989; 10: 531-5

22. Griswold, J. A., Grube, B. J., Engrav, L. H., and others. Determinants of donor si te infections in small burn grafts. J. Burn Care Rehabil., 1989, 10: 531-535. Hadjiiski O, Anatassov N. Amniotic membranes for temporary burn coverage. Ann Burns Fire Disasters 1996;9:88-92.

23. Greenhalgh DC, Barthel PP, Warden CD. Comparison of back versus thigh donor sites in pediatric patients with burns. J Burn Care Rehabil1993; 14: 21-5.

24. Gruss JS, Jirsch DW. Human amniotic membrane: A versatile wound dressing. Can Med Assoc J 1978;118:1237-46.

25. Ghalambor AA, Mohammad HP, Khodadadi A. The amniotic membrane: A suitable biological dressing to prevent infection in thermal burns. Med J Islamic Acad Sci 2000;13:115-8.

26. Gupta RL, Jain RK, Kumar M, et al. Fate of Collagen Sheet cover for artificially created raw areas (an experimental study). Indian J Surgery 1978; 40 (12) : 641-45

27. Gupta RL, Jain RK, Kumar M, et al. Role of collagen sheet cover in Burns. (A Clinical study). Indian J Surgery 1978; 40 (12) : 646-49

28. P Halankar, D Cunha-Gomes, C Chaudhari -Collagen Dressing in The Management of Donor Site of Split Thickness Skin Grafts

29. Horch RE, Stark GB. Comparison of the effect of a collagen dressing and polyurethane dressing on healing of split thickness skin graft donor sites. Scand J Plast Reconst Surg Hand Surg 1998; 32 (4) : 407-13

30. Hutchinson JJ, McGuckin M. Occlusive dressings: a microbio-logic and clinical review. Am J Infect Contr 1990; 18: 257-68

31. Hunt TK. Basic principles of wound healing. J Trauma 1990; 30: s122.

32. Hynes RO. Integrins: versatility, modulation, and signaling in cell adhesion. Cell. 1992;69(1):11–25.

33. James, J. H., and Watson, A. C. H. The use of Opsite, a vapour permeable dressing, on skin graft donor sites. Br. J. Plast. Surg., 1975, 28: 107-110.

34. Jeffrey J. Metalloproteinases and tissue turnover. WOUNDS. 1995;7(Suppl A):13A–22A.

35. Kilinc H, Sensoz O, Ozdemir R, Unlu RE, Baran C. Which dressing for split thickness skin graft donor site? Ann Plast Surg 2001; 46 (4) : 409-14.

36. Klein CE, Dressel D, Steinmayer T, et al. Integrin alpha 2 beta 1 is upregulated in fibroblasts and highly aggressive melanoma cells in three-dimensional collagen lattices and mediates the reorganization of collage I fibrils. J Cells Biol. 1991;115(5):1427–1436.

37. Krieg T. Collagen in the Healing Wound. WOUNDS. 1995;7(Suppl A):5A–12A.

38. Kan Gruber D, Gruber C, Seifter E, et al. Acceleration of wound healing by Staphylococcus aureus. Surg Forum 1981; 32: 768

39. Leicht, P., Siim, E., and Sorensen, B. Treatment of donor sites-Duoderm or Omiderm. Burns Incl. Therm. lnj., 1989, 15: 7-10.

40. Laforet EC. Wound dressing or window dressing? Arch Surg 1974; 109: 457.

41. Lazovic G, Colic M, Grubor M, Jovanovic M. The application of collagen sheet in open wound healing. Ann Burns Fire Disasters 2005;18:151

42. Madden, M. R, Finkelstein, J. L., Hefton, J. M., and Yurt, R W. Optimal healing of donor site wounds with hydrocolloid dressings. In: An Environment for Healing: The Role of Occlusion. Edited by T. J. Ryan. Pp. 133-137. London: RoyalSociety ofMedicine, 1985.

43. Madden MR, Nolan E, Finkelstein JL, er al. Comparison of an occlusive and semiocclusive dressing and effect of the wound exudate upon keratinocyte proliferation. J Trauma 1989; 29: 924

44. Madri JA, Marx M. Matrix composition, organization, and soluble factors: modulators of microvascular cell differentiation in vitro. Kidney Int1992;41(3):560–565

45. Mignatti P, Rifkin DB, Welgus HG, Parks WC. Proteinases and tissue remodeling. In: Clark RAF, ed. The Molecular and Cellular Biology of Wound Repair. 2nd ed. New York, NY: Plenum Press; 1996:427–474

46. Mohammadi1 AA, Riazi1 H, Hasheminasab MJ, Sabet B, Mohammadi MK, Abbasi S, et al. Amniotic membrane dressing v/s conventional topical antibiotic dressing in hospitalized burn patients. Iranian Red Crescent Med J 2009;11:66-70.

47. Montesano R, Orci L, Vasselli P. In vitro rapid organization of endothelial cells into capillary-like networks is promoted by collagen matrices. J Cell Biol. 1983;97(5 Pt 1):1648–1652

48. Motta G, Ratto GB, De Barbieri A, Corte G, Zardi L, Sacco A, et al. Can heterologous collagen enhance the granulation tissue growth? An experimental study. Ital J Surg Sci 1983;13:101-8.

49. Nanney LB. Epidermal growth factor-induced effects on wound healing. [Abstr.] Clin Res 1987; 35: 706A.

50. Nataraj C, Ritter G, Dumas S, Helfer FD, Brunelle J, Sander TW. Extra cellular wound matrices: Novel stabilization and sterilization method for collagen-based biologic wound dressings. Wounds 2007;19:148-56.

51. Nagata H, Ueki H, Moriguchi T. Fibronectin: Localization in normal human skin, granulation tissue, hypertrophic scar, mature scar, progressive systemic sclerotic skin, and other fibrosing dermatoses. Arch Dermatol 1985;121:995-9.

52. Park SN, Lee HJ, Lee KH, Suh H. Biological characterization of EDC-crosslinked collagen-hyaluronic acid matrix in dermal tissue restoration. Biomaterials 2003;24:1631-41.

53. Palmieri B. Heterologous collagen in wound healing: a clinical study. IntJ Tissue React. 1992;14(Suppl):21–25.

54. Parks WC. The production, role, and regulation of matrix metalloproteinases in the healing epidermis. WOUNDS. 1995;7(Suppl A):23 37

55. Petersen MJ, Woodley DT, Stricklin GP, O'Keefe EJ. Enhanced synthesis of collagenase by human keratinocytes cultured on Type I or Type IVcollagen. J Invest Dermatol. 1990;94(3):341–346.

56. Ponten B, Nordgaard JO. The Use of Collagen Film as a Dressing for Donor Areas in split skin grafting. Scand J Plast Reconstr Surg 1976; 10 : 237-40.

57. Porter JM. A comparative investigation of Re epithelialisation of split skin graft donor areas after application of hydrocolloid and alginate dressings. British J Plastic Surgery 1991; 44 : 333-37.

58. Prasad,J. K, Fel1er, l., and Thompson, P. D. A prospective controlled trial of Biobrane versus Scarlet Red on skin graft donor afeas. J. Burn Care Rehabil.,1987,8: 386.

59. Ramakrishnan KM, Jayaraman V. Management of partial-thickness burn wounds by amniotic membrane: A cost effective treatment in developing countries. Burns 1997;23:S33-6.

60. Robson MC, Lea CE, Dalton JB, Heggers JP. Quantitative bacteriology and delayed wound closure. Surg Forum 1968,19: 501-2.

61. Richmond, J. D., and Sutherland, A B. A new approach to the problems encountered with Opsite as a donor site dressing: systemic). Br. J. Plast.Surg.,1986,39: 516-518.

62. Roberts, L. W., McManus, W. F., Mason, A. D., and Pruitt, B. A. Duoderm in the management of skin graft donor sites. In: Surgical Research: Recent Developments. Edited by C. W. Hall. Proceedings of the 1st Annual ScientificSession of the Academy of Surgical Research. Pp. 55-58. San Antonio, Texas: Pergamon

63. Salisbury, R. E., Wilmore, D. W., Silverstein, P., and, B. A. Biologic dressings for skin graft donor sites. Arch. Surg., 1973, 106: 705-706. .Gemberling, R M., Miller, T. A., Caffee, H., and Zawacki, B. E. Dressing comparison in the healing of donor sites. J. Trauma., 1976, 16: 812-814

64. Skouge, J. W. Techniques for split-thickness skin grafting. J. Dermatol. Surg.Oncol., 1987, 13: 841- 849

65. Schiro JA, Chan BM, Roswit WT, et al. Integrin alpha 2 beta 1 (VLA-2)mediates reorganization and contraction of collagen matrices by human cells. Cell. 1991;67(2):403–410.

66. Scharffetter-Kochanek K, Klein CE, Heinen G, et al. Migration of human keratinocyte cell line (HaCaT) to interstitial collagen Type I is mediated by the alpha 2 beta 1-integrin receptor. J Invest Dermatol. 1992;98(1):3–11.

67. Subdeck BD, Parks WC, Welgus HG, Pentland AP. Collagen-stimulated induction of keratinocyte collagenase is mediated via

tyrosine kinase and protein kinase C activities. J Biol Chem. 1994;269(47):30022–30029.

68. Schultz G, Mast B. Molecular analysis of the environment of healing and chronic wounds: cytokines, proteases and growth factors. WOUNDS.1998;10(6 suppl):1F–9F.

69. Sibbald RG, Williamson D, Orsted HL, et al. Preparing the wound bed debridement, bacterial balance, and moisture balance. Ostomy Wound Manage. 2000;46(11)14–35.

70. Schultz GS, Sibbald RG, Falanga V, et al. Wound bed preparation: a systematic approach to wound management. Wound Repair Regen.2003;11(Suppl 1):1–28.

71. Smith DJ, Thomson PD, Bolton LL, Hutchinson JJ. Microbiology and healing of the occluded skin-graft donor site. Plast Reconst Surg 1993; 91: 1094-7.

72. Teplitz C, Davis D, Mason AD, Moncrief JA. Pseudomonas burn wound sepsis. I. Pathogenesis of experimental burn wound sepsis. J Surg Res 1964; 4: 200-16.

73. Tenorio A, Jindrak K, Weiner M, et al. Accelerated healing in infected wounds. Surg Gynecol Obstet 1976; 142: 537-43.

74 Varghese, M. C., Balin, A. K, Carter, M., and Caldwel1, D. Local environment of chronic wounds under synthetic dressings. Arch. Dermatol., 1986, 122: 52- 57.

75. Veves A, Sheehan P, Pham HT. A randomized, controlled trial of promogran (a collagen/oxidized regenerated cellulose dressing) vs standard treatment in the management of diabetic foot ulcers. Arch Surg. 2002;137:822-7

76. Weber RS, Hankins P, Limitone E, et al. Split-Thickness Skin Graft Donor Site Management. A Randomised Prospective Trial Comparing a Hydrophilic Polyurethane Absorbent Foam Dressing with a petroleum gauze Dressing. Arch Otolaryngol Head Neck Surg 1995; 121 (10) : 1145-9

77. Winter CD. Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. Nature 1962; 193: 293-4.

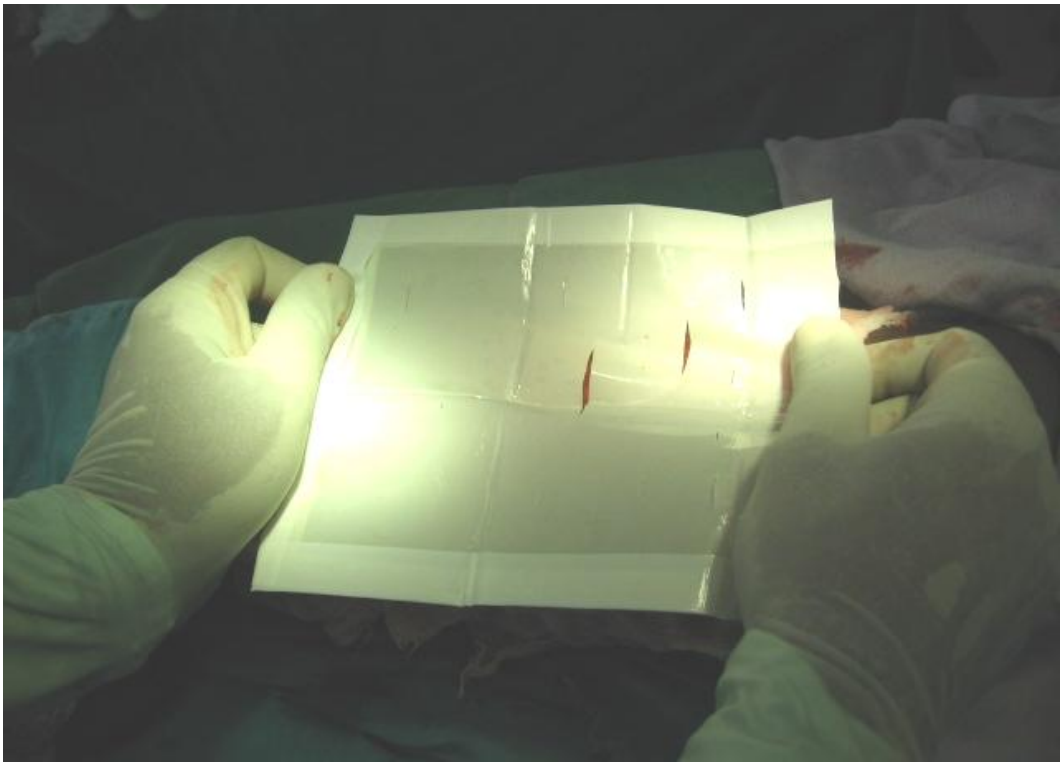
78. Zapata-Sirvent, R, Hansbrough, J. F., Carroll, W., and others. Comparison of Biobrane and Scarlet Red dressings for treatment of donor site wounds. Arch.Surg., 1985, 120: 743

CLOSED DRESSING

HAEMOCOAGULASE WITH COLLAGEN SHEET DRESSING

HAEMOCOAGULASE APPLICATION

SIEVED COLLAGEN SHEET



COLLAGEN SHEET APPLIED TO DONOR SITE

DONOR SITE HEALING – COMBINATION DRESSING 1

DONOR SITE HEALING – COMBINATION DRESSING 2

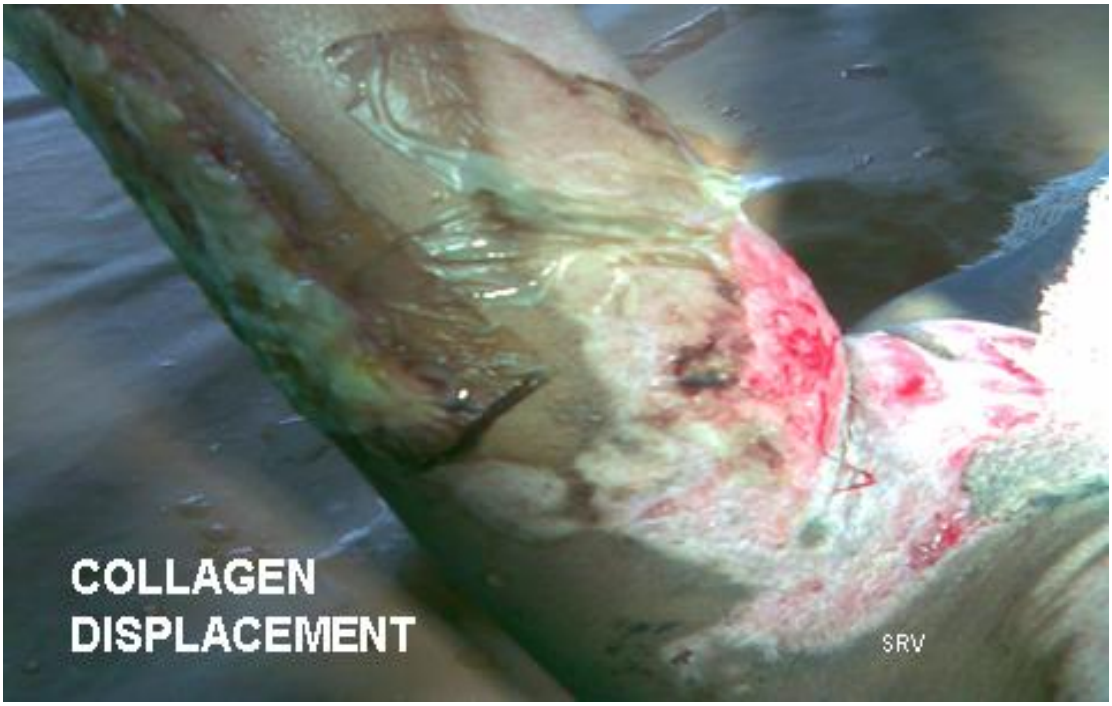
DONOR SITE HEALING – COMBINATION DRESSING 3

HAEMOCOAGULASE WITH COLLAGEN SHEET FOR ANTERIOR AND LATERAL THIGH DONOR SITE

REEPITHELISATION OF DONOR SITE

DONOR SITE COMPLICATIONS

DISPLACEMENT OF COLLAGEN SHEET



NAME	AGE	SEX	IP NO	CLOSED	DONOR	SIZE(cm)	PAIN	AMBULATION	REVIEW REMARKS	REEPITHELISATION	SOAKAGE	INFECTION	DATE OF SURGERY
				DRESSING	SITE			POD					
SUDHARSAN	28	MALE	29230	YES	L(T)	25X30	4	3		20	MINIMAL	NIL	14/12/09
MOHAN	39	MALE	29236	YES	R(T)	25x30	4	3		20	MODERATE	NIL	17/12/O9
SAROJA	28	FEMALE	29302	YES	L(T)	25X30	6	4	FOUL SMELLING	29	SEVERE	STAPH.AUREUS	3/12/2009
MEENAKSHI	29	FEMALE	29315	YES	L(T)	15X25	5	2		21	MODERATE	NIL	5/12/2009
RAJA	30	MALE	29381	YES	L(T)	20X25	5	4		20	MODERATE	NIL	17/12/09
PADMAVATHY	32	FEMALE	29350	YES	L(T)	25X30	3	3		20	MODERATE	NIL	24/12/09
DEVI	36	FEMALE	29354	YES	L(T)	25X30	5	3		20	MODERATE	NIL	12/12/2009
NATARAJAN	39	MALE	29366	YES	L(T)	20x30	4	4		21	MODERATE	NIL	16/12/2009
SUGUNA	26	FEMALE	29386	YES	R(T)	25x30	5	3		20	MODERATE	NIL	12/12/2009
PANNERSELVAM	39	MALE	29402	YES	R(T)	20x30	5	3		21	MODERATE	NIL	3/1/2010
RAJAKUMARI	27	FEMALE	10171	YES	R(L)	10x15	4	2		20	MINIMAL	NIL	7/1/2010
ROSELINE	39	FEMALE	10196	YES	L(T)	15X25	4	2		20	MINIMAL	NIL	21/01/2010
THIRUMAL	40	MALE	10251	YES	L(T)	25X30	5	4	FOUL SMELLING	30	MODERATE	STAPH.AUREUS	3/2/2010
VENKATESAN	42	MALE	10457	YES	L(T)	25X30	4	4		21	MODERATE	NIL	22/02/2010
SRIDHAR	27	MALE	11036	YES	L(T)	25X30	5	3		21	MODERATE	NIL	7/3/2010
SARAVANAN	28	MALE	12781	YES	L(T)	25X30	6	4	FOUL SMELLING	30	SEVERE	STAPH.AUREUS	15/03/2010
SIVAGAMI	32	FEMALE	12861	YES	R(T)	25X30	4	4		20	MODERATE	NIL	21/03/2010
SURESH	29	MALE	13741	YES	R(T)	25X30	4	3		20	MODERATE	NIL	3/4/2010
SARALA	36	FEMALE	14501	YES	R(T)	20X25	5	3		20	MINIMAL	NIL	14/04/2010
SOUMYA	17	FEMALE	14556	YES	L(T)	15x25	5	3		20	MODERATE	NIL	18/04/2010
MANI	41	MALE	15771	YES	L(T)	20x30	5	2		21	MODERATE	NIL	4/5/2010
SHANTHI	28	FEMALE	15892	YES	L(T)	20x30	5	3		20	MODERATE	NIL	11/5/2010
LAKSHMI	24	FEMALE	16402	YES	L(T)	20x30	5	2		20	MODERATE	NIL	27/05/2010
DHANALAKSHMI	26	FEMALE	17819	YES	L(T)	20x30	4	3		20	MODERATE	NIL	6/6/2010
VISWANATHAN	39	MALE	18721	YES	R(T)	25X30	5	4		20	MODERATE	NIL	10/6/2010
MANIKANDAN	25	MALE	20231	YES	L(T)	25X30	3	4		21	MODERATE	NIL	17/06/2010
PUSHPARAJ	43	MALE	20239	YES	L(T)	25X30	6	4	FOUL SMELLING	31	MODERATE	STAPH.AUREUS	15/07/2010
MARIAPPAN	39	MALE	22214	YES	R(T)	15x25	4	2		20	MINIMAL	NIL	12/8/2010
RAMANAN	37	MALE	22291	YES	R(T)	15x25	4	3		20	MODERATE	NIL	21/09/2010

MAHALINGAM	35	MALE	22317	YES	L(L)	10x15	4	3		20	MINIMAL	NIL	2/10/2010
SUSEELA	32	FEMALE	24331	YES	R(T)	25X30	5	3		21	MODERATE	NIL	17/10/2010
BALAN	30	MALE	25430	YES	R(T)	25X30	5	4	FOUL SMELLING	30	MODERATE	STAPH.AUREUS	3/11/2010
ASHOK	24	MALE	10871	YES	R(T)	20x30	5	3		20	MODERATE	NIL	28/11/2010
KUMAR	26	MALE	11782	YES	L(T)	20x30	4	4		20	MODERATE	NIL	24/12/2010
ARUMUGAM	40	MALE	12001	YES	L(T)	20x30	4	3		20	MODERATE	NIL	5/1/2011
RAGHU	36	MALE	12585	YES	L(T)	20x30	6	4	FOUL SMELLING	30	SEVERE	STAPH.AUREUS	22/01/2011
AKILESHWARI	25	FEMALE	13145	YES	L(T)	15x25	5	3		20	MODERATE	NIL	3/2/2011
GOVINDARAJ	51	MALE	14392	YES	L(T)	15x25	5	2		21	MODERATE	NIL	9/2/2011
VELUSAMY	47	MALE	14953	YES	R(T)	25X30	5	4		20	MODERATE	NIL	3/3/2011
NARAYANAN	32	MALE	15745	YES	R(T)	25X30	4	4		20	MODERATE	NIL	15/03/2011
POWN	34	FEMALE	16709	YES	L(T)	20x30	4	4		20	MODERATE	NIL	19/03/2011
GOWRI	26	FEMALE	17123	YES	R(T)	20x30	4	4		20	MODERATE	NIL	3/4/2011
VISHNU	24	MALE	17789	YES	R(T)	25X30	4	4		20	MODERATE	NIL	6/5/2011
PADMINI	45	FEMALE	19254	YES	R(T)	15x25	5	2		21	MODERATE	NIL	3/6/2011
SENTHIL	25	MALE	20258	YES	R(T)	15x25	5	3		20	MODERATE	NIL	17/7/2011
KUMARAN	29	MALE	22354	YES	R(T)	15x25	5	4	FOUL SMELLING	29	SEVERE	STAPH.AUREUS	21/10/2011
LAKSHMI	22	FEMALE	22514	YES	L(T)	15x25	4	2		20	MODERATE	NIL	27/10/2011
MURUGAN	35	MALE	10971	YES	L(T)	20x30	5	3		21	MODERATE	NIL	12/11/2011
SHAKILA	21	FEMALE	1009	YES	L(T)	20x30	4	3		20	MODERATE	NIL	3/1/2012
MEHRUNISHA	24	FEMALE	1257	YES	L(T)	15x25	4	2		20	MINIMAL	NIL	21/01/2012

NAME	AGE	SEX	I.P No	DATE OF SURGERY	DONOR SITE	SIZE(cm)	HAEMOCOAGULASE	COLLAGEN SHEET	PAIN	AMBULATION	REVIEW REMARKS	REEPITHELISATION	INFECTION
VINITHA	16	FEMALE	29230	14/12/2009	L(T)	15X30	YES	YES	2	1		15	NIL
SANDHYA	9	FEMALE	29452	18/12/2009	L(T)	25X30	YES	YES	2	1		15	NIL
ANNAMALAI	35	MALE	29232	12/12/2009	L(T)	25X30	YES	YES	2	1		17	NIL
HIYAKATHULLAH	30	MALE	29515	18/12/2009	L(T)	25X30	YES	YES	3	2		15	NIL
SASIKALA	20	FEMALE	11052	27/12/2009	R(T)	25X30	YES	YES	2	2		17	NIL
PRIYA	25	FEMALE	11534	6/12/2009	L(T)	25X30	YES	YES	4	1		16	NIL
THIRUPURA SUNDARI	65	FEMALE	11896	22/12/2009	L(T)	10X15	YES	YES	1	1		17	NIL
LOGANATHAN	29	MALE	12758	3/1/2010	L(L)	15X30	YES	YES	2	2		15	NIL
SURESH	25	MALE	13564	12/1/2010	R(T)	15X30	YES	YES	2	1		15	NIL
LAKSHMI	32	FEMALE	14011	27/01/2010	R(T)	15X30	YES	YES	3	1		17	NIL
DHATCHAYANI	30	FEMALE	14545	6/2/2010	R(T)	25X30	YES	YES	2	2		15	NIL
RATHI	23	FEMALE	15149	24/02/2010	R(T)	15X20	YES	YES	2	1		15	NIL
SELVI	26	FEMALE	16188	3/3/2010	L(T)	20X30	YES	YES	2	1		15	NIL
VANITHA	35	FEMALE	18433	23/03/2010	L(T)	15X20	YES	YES	1	1		15	NIL
ANITHA	28	FEMALE	19010	2/4/2010	L(T)	15X20	YES	YES	1	2		16	NIL
MANOHAR	49	MALE	19581	17/04/2010	L(T)	25X30	YES	YES	3	1		17	NIL
PRABHA	17	MALE	20039	21/04/2010	L(T)	25X30	YES	YES	2	1		17	NIL
PARI	40	MALE	21051	4/5/2010	R(T)	25X30	YES	YES	4	3	INFECTION+	20	staph.aureus
GEMINI	25	MALE	22007	15/05/2010	R(T)	25X30	YES	YES	3	2		16	NIL
KEERTHIKA	19	FEMALE	22678	19/05/2010	L(T)	20X30	YES	YES	3	1		15	NIL
DHANALAKSHMI	55	FEMALE	22912	12/6/2010	L(T)	20X30	YES	YES	2	2		16	NIL
BHUVANESHWARI	24	FEMALE	23439	17/06/2010	L(T)	20X30	YES	YES	2	1		16	NIL
VIDHYA	23	FEMALE	23931	4/7/2010	L(T)	20X30	YES	YES	3	1		16	NIL
NANDHINI	15	FEMALE	23974	17/07/2010	R(L)	25X30	YES	YES	3	2		16	NIL
MATHIALAGAN	42	MALE	24117	27/07/2010	L(T)	25X30	YES	YES	2	2		17	NIL
JANCY	29	FEMALE	24616	16/08/2010	L(T)	25X30	YES	YES	2	1		15	NIL

BALU	25	MALE	24938	23/08/2010	R(T)	15X20	YES	YES	1	1		15	NIL
SATHYA	17	FEMALE	12065	11/9/2010	R(T)	15X20	YES	YES	2	2		15	NIL
KANNAN	19	MALE	12679	23/09/2010	R(T)	15X20	YES	YES	2	1		15	NIL
ILAYARAJA	25	MALE	13119	13/10/2010	R(T)	15X30	YES	YES	3	2		17	NIL
THILOTHAMAL	35	FEMALE	13474	11/11/2010	R(T)	15X30	YES	YES	2	2		16	NIL
SUMITHRA	26	FEMALE	13675	7/12/2010	L(T)	15X30	YES	YES	2	1		17	NIL
KALAI SELVI	24	FEMALE	15153	7/1/2011	L(T)	15X20	YES	YES	3	1		15	NIL
VASANTH	24	MALE	16117	3/2/2011	L(T)	15X20	YES	YES	2	2		15	NIL
SRIKANTH	25	MALE	16297	27/02/2011	L(T)	15X20	YES	YES	2	1		16	NIL
YUVARAJ	21	MALE	16537	7/3/2011	L(T)	20X30	YES	YES	2	1		16	NIL
ALEX	30	MALE	17103	15/03/2011	L(T)	20X30	YES	YES	2	2		17	NIL
SRINIVASAN	34	MALE	17539	12/4/2011	R(T)	20X30	YES	YES	2	1		16	NIL
MUTHU	30	,ALE	17714	14/05/2011	R(T)	20X30	YES	YES	3	2		15	NIL
RAMACHANDRAN	18	MALE	17912	3/6/2011	R(T)	25X30	YES	YES	4	3	INFECTION +	23	staph.aureus
SINGARAJ	45	MALE	18215	6/6/2011	R(T)	25X30	YES	YES	1	2		15	NIL
MARIMUTHU	45	MALE	18456	16/07/2011	L(T)	25X30	YES	YES	3	1		16	NIL
KUMARI	23	FEMALE	18509	28/07/2011	L(T)	15X20	YES	YES	3	1		16	NIL
SAKTHIVEL	30	MALE	19004	20/11/2011	L(T)	15X20	YES	YES	2	2		16	NIL
SARAVANA KUMAR	26	MALE	20031	24/11/2011	L(T)	15X20	YES	YES	2	1		16	NIL
NOORULA KHAN	40	MALE	21237	2/12/2011	R(T)	15X20	YES	YES	2	2		17	NIL
SASI KUMAR	24	MALE	22549	7/12/2011	R(T)	20X30	YES	YES	4	1		16	NIL
GUNASUNDARI	36	FEMALE	23112	23/12/2011	R(T)	25X30	YES	YES	3	2		16	NIL
BASKAR	35	MALE	10975	O2/01/2012	L(T)	15X20	YES	YES	1	2		16	NIL
ARUL	30	MALE	1151	6/1/2012	L(T)	15X20	YES	YES	2	2		16	NIL